

Impacts of insufficient instructional materials on teaching biology: Higher education systems in focus

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Abstract

The purpose of this study was to assess and determine impacts of insufficient instructional materials and ineffective lesson delivery methods on teaching in biology higher education. The participants of this study were 60 trainees who graduated in Bachelor of Sciences from eight public universities in majoring biology. Data for the study was collected while these trainees were attending the course of Biology Teaching Methods in the Post Graduate Diploma in Teaching, both in the regular and summer 2015/2016 training programs at Addis Ababa University. The study employs a mixed method design of both qualitative and quantitative data evaluations. Data was collected through classroom observations and interviews with the trainees. The findings indicated that insufficient instructional materials and ineffective teaching methods in higher education had negative impacts; that have affected the skills of performing biological tasks of graduates 71%. In the course of the Post Graduate Diploma in Teaching training, trainees were unsuccessful to conduct essential biological tasks expected from graduates of biology upon the completion of their undergraduate study program. The study was concluded with emphasis on the need to integrate theory and practice through using adequate instructional materials and proper teaching methods in the higher education biology teaching.

Keywords: systems, instruction, materials, insufficient and soft data.

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1. Introduction

Instructional materials of higher education systems are designated contents of courses for transferring essential knowledge or skills to students to enable them to acquire factual ideas and develop professional careers. In this study, instructional materials for the undergraduate program of biology include: Course outlines, scripts, modules, reference materials, lab manuals, lecture notes, teaching aids and template guidance to conduct tasks practically. The study was designed to determine the impacts of insufficient biology instructional materials and learning facilities in some public universities in Ethiopia on the trainees' knowledge of the subject biology and its practicalities. It means instructional materials and resources for delivering biology courses of the undergraduate program were insufficient during their course of study at the university. Upon completing the undergraduate program majoring in biology, some of the graduates joined the Post Graduate Diploma in Teaching (PGDT) teachers training of biology at Addis Ababa University. The researcher had an opportunity to teach the course Biology Teaching Methods in the regular and summer programs. The issue of impacts on biology teaching in higher education systems was thus identified while the trainees who joined the PGDT program were practicing how to teach biology. Trainees had difficulties in understanding the content knowledge as well as conducting designated tasks of classroom, lab and experimental activities of biology. In short, the candidates had very limited content knowledge of biology that they were trained to teach and were unable to develop expected abilities to perform professional jobs well enough in their future biology-teaching career. The purpose of the study was to assess and determine the impacts arising from insufficient instructional materials and poor or ineffective education systems in higher education of public universities on the skills and competencies of the trainees.

2. Methods

Data for the study was collected from sixty trainees of teaching biology while they were attending the Post Graduate Diploma in Teaching (PGDT) both in the regular and summer training programs at Addis Ababa University. Trainees were first-degree graduates in majoring biology and took the PGDT training in 2015/16 academic calendar to become secondary school biology teachers. The design of the study was a mixed method one in which both qualitative and quantitative data evaluations and descriptive approaches were used to explain the negative effects of insufficiency of instructional materials and higher education systems on teaching biology. Data was gathered through classroom observations and interviews. Classes taught by sixty candidates involved in the PGDT program were observed and data was collected from these classroom observations using checklists. In addition, data was gathered using interview questions from twenty candidates of the sixty who were involved in the program. Classroom observation checklist was set to gather, quantify and qualify empirical data in measurable terms through variables. The variables of the checklist focused on measuring, valuing and scoring the skills and abilities of the trainees to;

- Discuss and explain contents knowledge of biology
- Perform biology tasks on operating microscopes and simple pieces of lab equipment, and
- Work in lab and conduct simple experiments individually and/or in groups

All variables of the tasks set to be performed by the trainees were measured in terms of how much of the content of each task was properly done, tried, remained untouched, arranged, valued and scored in percentile (Table 1).

Table 1. Classroom observation of trainees on conducting practical tasks of biology

Tasks	Performance status of the tasks	Score of performances
Discussing the content knowledge	Had good conceptualization and definitions	32%
	Missed much and reflected little knowledge	68%
Microscopy	Understood some of the concepts and uses	18%
	Unable to understand and operate microscopes easily	82%
Biology lab activities	Lab works, observation and identification of objects	31%
	Faced difficulties in lab works, identifying objects and writing lab reports	69%
Simple experiments in biology	Skills of demonstrations and uses of minds-on and minds on in the lab works	22%
	Incompetent to use equipment, handle chemicals and do designated experiments	78%
Assignments	Showed accurate understandings of given tasks	42%
	Were incompetent to conduct any piece of task	58%
Over all task performances	conducted given tasks across population	29%
	Unsuccessful to do biological tasks (incompetency)	71%

Respondents to interview questions were twenty trainees graduated in majoring biology from eight different public universities who joined the PGDT training program to become secondary school biology teachers at Addis Ababa University. Interview questions focused on assessing and determination of impacts arising from insufficiency of teaching biology during the students' study at the undergraduate program of universities to complete their first degree in biology. It included:

- Access of students to required instructional materials (course outlines, reading materials, guidelines, reference materials and learning facilities)
- Access to quality education systems (teaching, practical learning and assessment techniques)
- Access to supportive experiences and practical exercises

Respondents provided their responses to interview questions, both in oral and written forms that were arranged and provided scores in percentile were used for evaluation and analysis of data (Table 2).

Table 2. Responses to interview questions on the quality of higher education systems

Interview questions	Variables of impacts of learning facilities	Status of inputs in higher education	
		The status of inputs	Scores of inputs
Did you have full access to all instructional materials for the BSC study courses?	Course outlines and guidelines	New course outlines	65%
		Old copies	20%
		Missing	15%
	Instructional materials	Handouts	52%
		Lecture notes	33%
		Missing	15%
	References materials	Campus libraries	29%
Individual searches		31%	
Missing		40%	
How do you judge the teaching methods and its effectiveness throughout your BSC study?	Teaching methods	Student-centered	27%
		Traditional	59%
	Practical activities of biology class	Missing methods	14%
		Ineffective lab	42%
		Simple experiments	14%
How do you explain the assessment techniques your Instructors used throughout your BSC study?	Continuous assessments	Missing	44%
		Tests	28%
	Exams	Practical assignments	2%
		Termed exams	70%
	Conveyed learning in the higher education	Effective	43.17
	Ineffective or missing	56.83	

2.3 Data Evaluation and Analysis

Classroom observations focused on what higher graduates majoring in biology perform as an output of the higher education systems. The evaluation of observation on the practical performances of graduates attending the teachers training program of PGDT to become teachers of biology was on the bases of set checklists to assess and value what graduates of biology conducted of the assigned tasks practically. Checklists were used to promptly value and score the performances of each trainee in executing given tasks of classroom discussion, operation of microscopes and uses of equipment, lab works, and realization of simple experiments within the contexts of learned courses. Accordingly, trainees as graduates of higher education majoring in biology overall, were successful by only 29% and were unsuccessful in the rest 71% of the expected tasks of biology (Table 1). The educational facets put into effect in higher education systems and conducted assigned tasks after graduation was ineffective confirming that the impact or educational insufficiency has that much affected the career of graduates. In view of the responses to the interview questions, the access to new course outlines was only about 65% of which the 20% were old copies and 15% of the trainees were unable to access to the materials throughout their first-degree courses of biology. Access to handouts was 52%; 33% used their own lecture notes and 15% of the students did not get any at all. Access to reference materials was 29%; about 31% used informal resources and 40% were completely left without materials. The access to new investigations of scientific researches of biology with the ongoing global level information was 60% and the rest of 40% did not get any. The teaching strategy of the higher education systems was 27% student-centered, 59% traditional and the rest 14% was through indirect contacts. Assessment techniques used in the higher education systems were 70% through termed exams, 28% quizzes and 2% assignments. Most of the teaching strategies were lecture methods or teacher-centered, depended on theory without practice and remained ineffective in which students sat for writing exams without any feedbacks or information on the course they were supposed to learn. The overall access to learning facilities in the higher education systems was 43.17% and the rest 56.83% was impacts arising from insufficiency of learning facilities and quality education. It shows that the quality of educational assets provided by the higher education systems was insufficient, distressing and impacted on all round development and capacity of biology graduates and made everything hard to cope with and do jobs. The participants of the study said, due to their lack of exposure to pertinent practical activities in biology courses during their course of study in the undergraduate program, they were unsuccessful at performing practical works of biology, which has heavily affected their career.

3. Results

The quality of teaching, learning and assessment techniques used in the universities from where the trainees graduated were very poor, theory and practice were dissociated. Access of students to instructional materials, resources and learning facilities were very scarce and limited to self-adherent searches of students. The result of the access of students to learning facilities and the quality of education in universities during their undergraduate program of learning biology courses was only 43.17% and the rest 56.83% of the required learning materials, resources and quality education of majoring in biology were insufficient (missed). The classroom observations and evaluations conducted by scoring the skills and abilities of PGDT trainees to conduct tasks of practical activities of biology to become secondary school biology teachers were assessed. It is represented that graduates were unsuccessful and incompetent to do provided professional tasks of biology practically by 71%. In view of this, the evaluation of classroom observations showed that the impacts arising from the shortages of instructional materials and quality education in general and practical exercise in particular has negatively affected the abilities and skills performances of biology graduates on doing professional careers. Lastly, the research was concluded with that in higher education, massification of higher institution without having qualified staffing, shortages of learning facilities and poor quality of

education that lacks practical activities have menaced and put heavy impacts on the skills and abilities of graduates to succeed in professional careers.

4. Discussion

In Ethiopian higher education, most of the required instructional materials were inadequate and first-degree graduates of biology were limited from access to learning facilities, educational resources and depended on old copies of some reading materials and their own notes to complete prescribed courses for the undergraduate program. Reisberg and Rumbley (2010) described that “most Universities of Ethiopia do not have the resources to effectively supervise or mentor so that many new and inexperienced instructors are assigned; research projects are often handed to less-experienced and less-qualified staff that constrained the quality of education”. This displays that in higher education learning facilities are insufficient and teaching methods are not well performed by reasoning in meaningful and memorable ways to bridge the gap between theory and practice and enable graduates to execute professional works of biology.

Koorosh (2015) described that “effective pedagogy incorporates an array of teaching strategies that support intellectual engagement and connectedness to the wider world”. The access to the new discoveries of biological research within the ongoing global contexts was very scarce so that biology graduates were tightly blocked from the influx of new information that could upgrade their understanding in biology courses. Assessment techniques commonly used to measure, mark and rank biology graduates during their stay in the universities were termed tests that lacked practical knowledge and corrective feedbacks within the time budget, in-actions and on-actions tasks. Most of the graduates of biology dissatisfied expected competences, lacked ability to demonstrate and perform activities related to the field of biology like the lab works and experiments.

In view of the higher education massification, Ashcroft (2010) described that “the expansion of university systems can lead to financial constraints and deteriorating conditions of study. The expansion of higher education institutions leads to more complex organizations, which requires more well-qualified administrative staff that available members have very limited abilities to develop systems to cope with more students, lack matching between employer and stakeholder requirements, curriculum and pedagogy and assessment methods”. The Ethiopian education system struggles to achieve more graduates without a noticeable loss of quality, but the condition so far is at serious disadvantages in finding sufficient instructional resources and qualified staff of higher educational systems.

In view of this, the European Commission report (2010b cited in the same report of 2011) states that “education and training can be effective and innovative only if the institutions themselves are innovative learning organizations and open to interactions with the world. Higher education systems must continue to evolve if they are to respond effectively to the skills needs of knowledge and challenges related to delivering high quality education to an even larger proportion of the population”. Teaching biology needs to concentrate on the delivery methods that address what and how a learner practically understands, avoid misconceptions and make use of the knowledge. However, the higher education systems missed the ability to construct transferable competencies needed to succeed and skills to perform professional works after graduation. It did not promote expected effective teaching methods that integrate practical activities to play essential roles in creating high quality of experience and enabling biology graduates to achieve competences and skills works.

In reference to this point, UNESCO (2009) described that “good teaching would focus on what teachers do primarily on what students learn”. Due to the reason that most of the higher education systems ignored attentions to the development of thoughtful experience and responsibilities of imparting practicable knowledge to the students, biology graduates ended with impracticable little knowledge and unemployment. European Universities Association (2015) described that “institutions

should ensure that the programs are delivered in a way that encourages students to take an active role in creating the learning process that respond to the needs of the society and reviewed periodically". Although many higher education institutions are currently trying to balance forces of instructional materials and educational systems to upgrade the quality of learning to the levels of required standards, little results were gained in doing so; 85% of the learning hours were corrupted by non-educational appointments. The current higher education curricula are often slow to respond to the changing needs, not only in biology but also in the wider fields and fail to anticipate or shape careers that facilitate opportunities of finding jobs. Among the various systems of learning facilities proposed so far, modular instruction is one of the newly introduced materials, which is either partly or entirely used in some higher education to alleviate the current problems to meet the needs of today's students with respect to the content knowledge and quality of learning than the traditional ways.

Ashcroft (2010), states "faculties found it hard to cope with the increased class sizes and tend to rely on traditional teaching methods, which seem easier and are more familiar, but fail to meet market needs, increasing the danger of graduates unemployment or underemployment that is inherent in an expanding system". In spite of this, biology graduates exercised little practical activities so that the time invested on learning remains wasted when the expected practical performances in biology remained ineffective. The issue of capacity constructing to perform biological tasks after completing higher education deals with the concept to what extent learners have understood, retained gained experiences and constructed skills of pertinent works. The process of teaching needs consistency and innovation of instructional materials and resources to execute pertinent practical activities of biology. The impacts were accelerated by the extension of the number of higher institutions and ignorance of educational facilities, adequate staffing with qualified professionals and ineffective teaching, learning and assessments.

4. Conclusion and Recommendation

4.1. Conclusion

The scenario of the higher education institutions today mostly emphasizes on the extension and production of graduates in mass, which is mismatching and putting great negative impacts on the professional quality of graduates and ended with increasing the numbers of unemployment. Overall, the relations between the current higher education teaching, learning and assessment efficiency were mostly dissociated from the required quality of making graduates proficient as well enabling of doing practical works. Although there are strong needs for innovative delivery methods to improve the quality of education, the escalating numbers of students joining the higher education institutions every year from different backgrounds, come up with the shortages of educational resources, facilities and qualified staffing to administrate the programs.

Qualification in any profession is an experience accumulated throughout attaining the full chains of elementary, primary, secondary and higher education systems with substantial coverage of the prescribed contents and if any of the chains are corrupted, the outcome faces several disadvantages. In fact, practice is increasingly the dynamic agent of changes in the academic landscape, but graduates of biology achieved little practice in materializing the concepts of biology and exercising practical activities during their three years of study at universities and lost self-confidence on the degree they hold.

4.2 Recommendations

Higher education systems are expected to provide practicable knowledge and expertise that could enable graduates to understand and do practically in relation to what they have learnt. Accordingly, the following points of solutions are recommended.

1. Ethiopian higher education systems require providing adequate instructional resources and facilities with qualified staffing who can transfer satisfactory expertise, sustain and provide practicable knowledge to graduates.
2. The instructional materials of biology of the higher education systems need to be consistent and content innovative to connect theory and practice that enable graduates to perform professional tasks.
3. Assessing areas of strengths and weaknesses in-action and on-action, feedbacks and renovation of the materials could maintain the balance of teaching and learning and minimize the overwhelming impacts of deficient teaching practices.
4. Implementations of minds-on and hands-on activities in biology lessons provide the best methods of solving the impacts and challenges graduates of biology face in practice.

In conclusion, the practical mismatch of theory and experience and the impacts of insufficient instructional materials and education systems including all schooling facilities have deteriorated the quality of higher education.

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