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A Critical Evaluation of the Four-Year B. Sc. Mathematics Curriculum at Tribhuvan University

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Abstract

A synopsis of the existing four-year B.Sc. mathematics curriculum offered by the Institute of Science and Technology is given. The main structure, the course's advantages and disadvantages, and some suggestions are provided. It is necessary to make improvements in the existing curriculum to maintain T.U.'s academic standards at the highest level worldwide. The objective of the four-year B.Sc. program still needs a lot of tweaking and adjusting. The author of mathematics textbooks should consider the aims and objectives of the subject matter taught in that class.

Keywords: *Curriculum, curriculum evaluation, textbook, syllabus*

Introduction

Universities across the world are essential for the growth and change of society. More than just forming conscious and engaged citizens and educating the next generation of thinkers, colleges also foster creativity and new ideas. Worldwide colleges educate their graduates using diverse educational systems. In practical terms, there are three sorts of education systems: semester, trimester, and yearly. An annual system is a conventional approach that gives students one full year to learn and absorb the material before having them sit for a comprehensive test after that time. Although this system has both objective and subjective components, the majority of its testing is done through comprehensive or subjective exams (KSC, 2022).

The Institute of Science and Technology (IOST) at Tribhuvan University launched the four-year B.Sc. degree in 2069 B.S. The curriculum was modified in 2073 B.S. to bring education standards up to par with those of other nations. T.U.'s bachelor's degree program now lasts four years instead of the previous three. The Higher Education Project (HEP) for

Nepal recommends this curriculum, which is a "one major multi-discipline program" that satisfies the worldwide norm for the Anglo-Saxon educational system. About half of the credits for the core course are awarded. The previous three-year major B.Sc. program has been expanded into this program. This program is still run annually using the percentage evaluation approach. In the future, T.U. plans to introduce a semester system. In the future, T.U. plans to implement a semester system and a grading (GPA) assessment system (IOST, 2073).

This paper examines the B.Sc. mathematics curriculum critically and looks for innovative and improvement opportunities (KSC, 2022).

Including Interdisciplinary Perspectives: The B.Sc. mathematics program should incorporate multidisciplinary perspectives to foster adaptable problem-solving skills and a comprehensive understanding of complex processes across various subjects.

Accepting Immersion Learning: Traditional lecture-based methods lack practical skills for today's workforce. Experiential learning opportunities like field visits, research projects, internships, and laboratory work are increasingly important for enhancing critical thinking, problem-solving, and collaboration abilities.

Improving Digital Literacy: The B.Sc. mathematics curriculum should prioritize enhancing students' digital literacy, including data analysis, programming, simulation, and visualization skills, to enable them to effectively use technology in academic and professional settings.

Developing Soft Skills: Employers prioritize soft skills like resilience, communication, leadership, and flexibility in the B.Sc. mathematics curriculum, enhancing students' personal and professional growth and increasing their employability through workshops, seminars, and extracurricular activities.

Encouraging Ethical Awareness: The B.Sc. mathematics curriculum should incorporate ethical principles, research conduct, and societal repercussions to foster ethical awareness and social responsibility among future scientists, ensuring constructive societal contributions.

Novelty : Higher education is a dynamic field that requires constant assessment and modification to satisfy the requirements of society and students. The Bachelor of Science (B.Sc.) mathematics program is a cornerstone in this regard, providing a basic education in a range of scientific areas. However, given the speed at which technology is developing and the way that global issues are changing, it is essential to reevaluate and improve the current four-year B.Sc. curriculum to make sure that it is still relevant and useful (KSC, 2022).

Up to now, mathematics has been taught as a required topic in the educational curriculum in secondary school. Currently, an elective topic level is required at this level at the secondary.

Significance : Critical evaluation of the B. Sc Mathematics curriculum is vital for maintaining its quality, relevance, effectiveness, inclusivity, and alignment with educational goals and societal needs. It ensures that students receive a comprehensive and rigorous education that prepares them for success in both academic and professional endeavors (KSC, 2022).

Quality Assurance: It ensures that the curriculum meets high standards of education and provides students with the necessary knowledge and skills to succeed in their academic and professional pursuits.

Relevance: Mathematics is a rapidly evolving field, with new concepts, theories, and applications emerging regularly. Critical evaluation helps ensure that the curriculum remains up-to-date and relevant to current trends and advancements in the field.

Alignment with Learning Objectives: Evaluating the curriculum helps ensure that it aligns with the intended learning objectives of the program. It ensures that students are equipped with the foundational knowledge and competencies expected of graduates in mathematics.

Pedagogical Effectiveness: Critical evaluation allows educators to assess the effectiveness of teaching methods, instructional materials, and assessment strategies used in the curriculum. This helps identify areas for improvement and optimization to enhance student learning outcomes.

Diversity and Inclusivity: Evaluation of the curriculum ensures that it reflects the diversity of mathematical concepts, perspectives, and applications. It helps identify and address any biases or gaps that may exist, ensuring inclusivity and accessibility for all students.

Preparation for Further Studies and Careers: A well-evaluated curriculum prepares students not only for further studies in mathematics but also for diverse career paths where mathematical skills are required. Evaluation helps ensure that the curriculum fosters critical thinking, problem-solving, and analytical skills essential for success in various professions.

Feedback Loop for Continuous Improvement: Critical evaluation establishes a feedback loop wherein feedback from various stakeholders, including students, educators, employers, and industry professionals, is gathered and incorporated into curriculum revisions. This iterative process facilitates continuous improvement and enhances the overall quality of the mathematics program.

Review of Literature

A four-year Bachelor of Science (B.Sc.) in Mathematics program is available at Tribhuvan University. This course is being offered by several institutions around the nation that are affiliated with and component of Tribhuvan University. Mathematics is used extensively in many fields, such as the social sciences, engineering, economics, humanities, and natural sciences (IOST, 2073).

T.U. housed its programmes exclusively on the universities that made up its constituents before 1980. With so many students pursuing higher education, it was not possible to accommodate them all on the campuses that made up the constituents. Private schools were founded as a result of this situation since the various campuses that made up the campus could not meet demand. 1079 bachelor's level courses and 1000 master's level courses are available at T. U. (Aryal, 2016).

The B.Sc. in Mathematics is offered both on and off campus at several institutions and universities around the nation. Students can find employment in actuarial sciences, statistics, modeling, computer sciences, cryptography, and other fields after receiving a B.S. in mathematics (IOST, 2078).

Before 2054, T.U. provided 2-year B.Sc. degrees; 3-year programs were introduced after that date. In 2069 T.U. started providing a four-year B.Sc. program in mathematics. T.U. revised its four-year curriculum in 2073. A four-year B.Sc. curriculum has been updated (IOST, 2073).

Paudel and Pokhrel (2019) talked about the current four-year B.Sc. chemistry program at Tribhuvan University's Institute of Science and Technology. The primary framework, the course's advantages and disadvantages, and suggestions are all provided. To keep T.U. academic standards up to par with worldwide standards, the current curriculum needs improving.

Larder (1967) researched Nepal's educational system, particularly concerning mathematics. He identified several flaws in the way mathematics is taught as well as in the way exams are administered. He suggested that the Mathematical Association of America assist Nepal's gifted pupils.

Objectives

The following are the goals of this paper:

(i) To investigate the shortcomings of the mathematics curriculum as well as the shortcomings of the B.Sc. Mathematics program.
(ii) To make some suggestions for improvements.

Organization and Contents

The structure of T.U.'s 4-year B.Sc. program was shown in Table 1 (Aryal, 2016). The easiest way to describe this construction, which is a three-tire to one-tire system, is in Figure 1 (IOST, 2078). An overview of a 4-year B.Sc. program's educational pyramid is provided in this figure 1.

Fourth year: one major subject
Third year: two major subjects
Second year: three major subjects
First year: three major subjects

Figure 1: Three-tire educational system of four-year B.Sc. Program of T.U. (Redrawn from Aryal, 2016).

Structure of B.Sc. 4-year system of T. U.

Table 1
Structure of B.Sc. 4 Years System of T.U.

Year	Description	Nature	Teaching hours	Full Marks
First year	Core course: two subjects	Theory	150 hours	75x2= 150
Second year	Core course: two subjects	Theory	150 hours	75x2= 150
Third year	Core course: two subjects and one elective course	Theory and lab	150 hours +75 hours	60+15=75+75=200
Fourth year	Core course (2+2 subjects) and one elective subject	Theory b+ theory Theory and Practical	150 hours each 75 hours 150 hours	100x2=200 50x2=100 100 Total: 400
Total marks				900

Table 2

The structure of the core Mathematics course for the 4-year B.Sc. programme

Year	Course Title	Course No.	Full Marks	Pass Marks
First Year	Calculus	MAT 101	75	26.5
	Analytical Geometry and Vector Analysis	MAT 102	75	26.25
Second Year	Linear Algebra	MAT 201	75	26.25
	Differential Equations	MAT 202	75	26.25
Third Year	Computer Programming	MAT 301	75 (60 Theory + 15 Lab)	26.25
	Real Analysis	MAT 302	75	26.5
	Elective (Any one)			
	(a)Numerical Methods	MAT 303	50	17.5
	(b) Discrete Mathematics	MAT 304	50	17.5
Fourth Year	Modern Algebra	MAT 401	100	35
	Mathematical Analysis	MAT 402	100	35
	Mechanics	MAT403	50	17.5
	Linear Programming	MAT 404	50	17.5
	(Elective: Any One)			
	Project Work	MAT 405	100	35
	Teaching Methodology	MAT 406	100	35
	Bio Mathematics	MAT 407	100	35
	Mathematical Economics	MAT408	100	35
	Mathematical Modeling	MAT 409	100	50
Total (Core + Elective)			900 Marks	

In Table 1, the T.U. four-year B.Sc. program's mathematics curriculum is laid out. The T.U. mathematics subject committee has prepared the specifics of these courses. The first year's coursework closely resembles the preceding four-year B.Sc. degree. Differential equation, which is taught in the second year of the redesigned 4-year B.Sc. degree, was

previously taught in the first. The third year of the redesigned 4-year B.Sc. degree introduces computer programming. The fourth year of the four-year redesigned B.Sc. program now offers two elective courses (Biomathematics and Mathematical Economics) (IOST, 2078).

The fourth year of the four-year B.Sc. program for the first group of students (2069 B.S.) was completed in 2073 B.S. The mathematics subject committee requested views and comments on the entire four-year mathematics curriculum from the mathematics departments of all T.U. component campuses after finishing the first batch. From the year of the 2073 B.S. admission batch, the 4-year B.Sc. curriculum has been slightly revised in response to criticism (IOST, 2073).

For the entire four-year term, IOST has planned a program for faculty orientation. All affiliated and constituent campuses have received the extended curriculum and sample final exam questions. Higher Secondary (+2 level) mathematics content and B.Sc. level content, as well as B.Sc. and M.Sc. level mathematics content, have a lot in common [1,6]. The +2 level and B.Sc. level curricula are not aligned (IOST, 2078).

Evaluation System

The four-year B.Sc. program uses an annual evaluation system with a % score. Every year, exams are held. Most of the questions are of the knowledge and application variety.

Eligibility

Tribhuvan University's B.Sc. in Mathematics program requires 10+2 or equivalent exam completion and a minimum "C" in Grades 11 and 12 math classes (NEB, 2022). The four-year B. Sc. in Mathematics program has a lengthy course structure, making it challenging to finish on time. Traditional papers, MAT 101 and MAT 403 are taught at a +2 level. The remaining exams cover calculus topics. The program falls short of global standards in optional paper options, topic knowledge, and practical mathematics exposure. In the fourth year, students will learn a basic programming language, introduce teaching methodology, and improve project work, presentation skills, and research standards (IOST, 2073).

(i) Some of the classical courses that are of no importance at the level have been introduced.
(ii) Most of the course is not new, so teacher does not pay much time to prepare for the class so that teaching is not effective.
(iii) The structure is not perfect.

(iv) Courses like basic multi-variable calculus for economics and life science, an integrated introduction to engineering Mathematics and physics, advanced multivariable calculus, advanced linear algebra with application, Mathematical neuroscience, cryptography, and analytic number theory have not been found.

Strengths and weakness of the Mathematics Curriculum

The strength of the Mathematics Curriculum:

The following are the strengths of this course:

- This is one major multi-disciplinary four-year B.Sc. programme, which contains almost 50% credit for the core mathematics course as per international standard.
- 4-years bachelor level education is beneficial for the students who wants to study higher education in abroad as they need 16 years of schooling, which is 10 + 2 + 4 system will provide. This will further help Nepalese students to meet the requirements of international education system.
- This course explores some multi-disciplinary area according to the need of nation for development.
- Computational course and Applied Statistics give the knowledge of data analysis and plotting at this level.
- Equal weight age has been given in pure and applied mathematics while designing the curriculum.
- Students get some exposure in research. Because research methodology and project work have introduced in 3rd and 4th year respectively, such type of courses motivates students in nurtured tools & techniques.
- As computational course and computer programming have introduced, it makes student sound in computer language & basic computer skills.
- Teaching methodology creates interest over treachery pedagogy in mathematics. After study of this paper student would be comfortable.

Weakness of curriculum:

- There is a lack of coordination between the content and the objective of the course.
- The content of the course emphasized more to the knowledge level, and less to skill, attitude development as well as application and observation skills.
- Society and science are not related.
- The wide and depth of the course is not mentioned.
- The research content of the course is only 5% (project works in fourth year) of total content and optional.
- There is no provision for continuous assessment of examination.
- The course is traditional, lacks self-employment and is career-oriented.

- Course content is too much lengthy and bit difficult to complete courses in due time.

Appropriateness

The 4-year B.Sc. program (old) was extended into this program. The program is still conventional, does not encourage self-employment, and is career-focused. There is no assurance regarding the placement service for the student after completing the four-year B.Sc. program. The course is not created with the student's needs or interests in mind. Teachers only interact with students orally and on the blackboard, which does not align with objectives.

Recommendation and Suggestions for improvements (CDM, 2079)

- The existing annual system 4-year B.Sc. program should be changed into a semester system. Similar to M.Sc. level, the GPA evaluation system should be introduced at the B.Sc. level also.
- There should be coordination between content and objectives.
- The wide and depth of the content should be clearly mentioned.
- There should be provision for continuous assessment of theory and practical.
- Additional elective or optional courses that link mathematics with life sciences should be added.
- The research content (project work) should be made compulsory. For this minimum research infrastructure is developed at constituent campuses.
- Frequent orientation and refresher training in theory, practical and research methodology should be provided to teachers of constituent campuses.
- For effective implementation of course, the teaching learning activity and research activity of constituent campuses should be monitored by concerned authority.
- Curriculum is the backbone of any academic program so it needs to be continuous as per the national and international need.
- Courses on applied Mathematics should introduced in both levels so that students' interest in the research in applied Mathematics may increase.
- Courses should be related to the student interest, everyday life and the needs of Nation.
- Curriculum should be including not only summative evaluation, there should include formative, continuous and internal assessment.

Advancement of the field of Research (KSC, 2022)

The field of critical evaluation of curriculum for four-year B.Sc. mathematics programs have seen significant advancements in recent years, driven by evolving educational philosophies, technological innovations, and changing societal needs. Here are some notable advancements:

Interdisciplinary Approach: There's a growing recognition of the importance of interdisciplinary studies in B.Sc. mathematics curricula. Many institutions are reevaluating traditional disciplinary boundaries and integrating diverse perspectives into their programs. This approach allows students to develop a broader understanding of complex issues and fosters creativity and innovation.

Integration of Technology: With the rapid advancement of technology, B.Sc. mathematics curricula are increasingly incorporating digital tools and platforms to enhance teaching and learning experiences. Virtual labs, simulation software, and online collaboration tools provide students with opportunities for hands-on experimentation and exploration, irrespective of physical constraints.

Active Learning Strategies: Traditional lecture-based teaching is being supplemented or replaced by active learning strategies such as problem-based learning, project-based learning, and flipped classrooms. These approaches promote student engagement, critical thinking, and collaboration, ultimately leading to deeper understanding and retention of course material.

Focus on Real-World Applications: There's a growing emphasis on aligning B.Sc. curricula with real-world applications and industry needs. Internships, co-op programs, and industry partnerships provide students with valuable practical experience and help bridge the gap between academia and the professional world.

Inclusive and Diverse Perspectives: Efforts are being made to make B.Sc. mathematics curricula more inclusive and diverse, both in terms of content and representation. This includes incorporating diverse voices and perspectives into course materials, as well as fostering a supportive and inclusive learning environment for students from all backgrounds.

Assessment and Evaluation Practices: Assessment and evaluation practices are being reexamined to ensure they are fair, transparent, and aligned with desired learning outcomes. There's a shift towards competency-based assessment, where students are evaluated based on their ability to demonstrate specific skills and knowledge, rather than

solely relying on traditional exams and grades.

Global Perspectives: B.Sc. mathematics curricula are increasingly incorporating global perspectives to prepare students for an interconnected world. This includes opportunities for international study, exposure to global issues, and cross-cultural communication skills development.

Ethical Considerations: As scientific and technological advancements raise ethical questions, B.Sc. mathematics curricula are integrating discussions on ethics, responsible conduct of research, and societal implications of scientific discoveries. This helps students develop a broader understanding of their roles and responsibilities as future scientists and professionals.

These advancements reflect a broader shift towards student-centered, inclusive, and innovative approaches to curriculum development in the field of B.Sc. mathematics. As the landscape continues to evolve, educators and curriculum developers will likely continue to explore new strategies and methodologies to enhance the quality and relevance of B.Sc. programs.

Conclusion

The four-year B.Sc. curriculum plays a pivotal role in shaping the next generation of scientists and innovators. By embracing interdisciplinary perspectives, experiential learning, digital literacy, soft skills development, and ethical awareness, educators can enhance the educational experience and equip students with the knowledge, skills, and values needed to thrive in a rapidly evolving world. As we embark on this journey of curriculum review and enhancement, let us remain committed to fostering excellence, innovation, and inclusivity in science education.

Tribhuvan University introduces a four-year bachelor's programme but needs revisions to the course's objectives, including rewriting the mathematics textbook.

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