



The Committee for the Evaluation of Mathematics Study-Programs

The Technion – Israel Institute of Technology

Evaluation Report

August 2010

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Chapter 1 - Background

At its meeting on October 07, 2008 the Council for Higher Education (CHE) decided to evaluate study programs in the fields of mathematics during the academic year 2009-2010.

Following the decision of the CHE, the Minister of Education, who serves ex officio as a Chairperson of the CHE, appointed a Committee consisting of:

- **Prof. Benedict H. Gross**, Mathematics Department, Harvard University, USA - Chair
- **Prof. Ronald Coifman**, Department of Mathematics and the Department of Computer Science, Yale University, USA
- **Prof. Hillel Furstenberg (emeritus)**, Department of Mathematics, the Hebrew University, Israel
- **Prof. Gerard van der Geer**, Korteweg-de Vries Institute for Mathematics, University of Amsterdam, the Netherlands
- **Prof. David Jerison¹**, Mathematics Departments, Massachusetts Institute of Technology, USA
- **Prof. Yakar Kannai**, Department of Mathematics, Faculty of Mathematics and Computer Science, Weizmann Institute, Israel

Ms. Noa Nof Steiner - Coordinator of the Committee on behalf of the Council for Higher Education.

Within the framework of its activity, the Committee was requested to:²

1. Examine the self-evaluation reports, submitted by the institutions that provide study programs in mathematics, and to conduct on-site visits at those institutions.
2. Submit to the CHE an individual report on each of the evaluated academic units and study programs, including the Committee's findings and recommendations.
3. Submit to the CHE a general report regarding the examined field of study within the Israeli system of higher education including recommendations for standards in the evaluated field of study.

The entire process was conducted in accordance with the CHE's Guidelines for Self-Evaluation (of October 2008).

¹ Prof. David Jerison did not participate in the second round of visits.

² The Committee's letter of appointment is attached as **Appendix 1**.

Chapter 2 - Committee Procedures

The Committee members received the self-evaluation reports in November, 2009, and discussed them via email.

The Committee held its first meeting on January 3, 2010, during which it discussed fundamental issues concerning higher education in Israel, the quality assessment activity, as well as mathematics study programs.

In January 2010, the Committee held its first cycle of evaluation, and visited the Open University, the Hebrew University, Tel-Aviv University and the Technion. In May 2010, the Committee conducted its second evaluation cycle, and visited Haifa University, Bar Ilan University and Ben-Gurion University of the Negev. During the visits, the Committee met with various stakeholders at the institutions, including management, faculty, staff, and students.

This report deals with the **Faculty of Mathematics at the Technion, Israel Institute of Technology**.

The Committee's visit at the Technion took place on January 13-14, 2010. The participating Committee members were Prof. Benedict H. Gross, Prof. Ronald Coifman, Prof. Hillel Furstenberg and Prof. Yakar Kannai. The schedule of the visit, including the list of participants from the institution, is attached as **Appendix 2**.

The Committee thanks the management of the Technion and the Faculty of Mathematics for their self-evaluation report and for their hospitality towards the Committee during its visit at the institution.

Chapter 3: Evaluation of the Faculty of Mathematics, the Technion

** This Report relates to the situation current at the time of the visit to the institution, and does not take account of any changes that may have occurred subsequently. The Report records the conclusions reached by the Evaluation Committee based on the documentation provided by the institution, information gained through interviews, discussion and observation as well as other information available to the Committee.*

Background

The Faculty of Mathematics at the Technion started originally as a service unit and grew to become an independent research department. Since 1960, the faculty awarded B.Sc. degrees to over 1200 students, M.Sc. degrees to more than 370 students and Ph.D. degrees to over 200 students. In addition to the mathematics graduate program, the Technion supports the "Technion Interdisciplinary Graduate Program in Applied Mathematics". This program consists of 11 departments from all over the campus and is run under the supervision of the dean of graduate studies.

During the 2007-2008 academic year, the Technion student population was about 12,400, of whom roughly 8,000 were at the undergraduate level and nearly 4,000 at the graduate level. The same academic year 196 undergraduate students, 43 master's level students, and 35 doctoral students, enrolled in the Faculty of Mathematics, and it granted 51 B.Sc. degrees, 8 M.Sc. degrees and 8 Ph.D. degrees.

The Faculty has provided the Committee in its Self Evaluation Report 2009 with an honest assessment of its strengths and weaknesses, highlighting the challenges it is currently facing. Some of the issues raised in their report were present in other Israeli institutions, and some were particular to the Faculty.

Faculty

The teaching and research personnel of the Faculty of Mathematics provide good coverage of many areas in mathematics. The research faculty have high level publications in the most prestigious mathematical research journals. They have also been very successful in obtaining research grants.

The age distribution of the faculty is of some concern, as many retirements have not been replaced. Consequently, the number of faculty members has gone from a peak of 55 a few years ago to 44 in 2009, while the challenges of teaching a huge body of

students have not diminished. The Committee understood that the situation seems to have stabilized and may improve in the near future.

Teaching and Learning

The Faculty of Mathematics at the Technion characterized its goal as providing excellent research and instruction in mathematics, both to mathematics students and to the general population of Technion students. The Committee has examined in detail all activities of the Faculty, and has been impressed by the scope of service it provides to the Technion, as well as by the creativity and leadership in responding to teaching challenges, while maintaining an active research activity in mathematics and applied mathematics.

On top of the basic programs in pure and applied mathematics, the Faculty offers joint programs with other Technion departments, including computer science, physics, and industrial engineering. The Faculty also supports the “Technion Interdisciplinary Graduate Program in Applied Mathematics”. This program, run under the supervision of the dean of Graduate studies, consists of 11 departments from all over the campus and offers M.Sc. and Ph.D. degrees in essentially all areas of applied mathematics.

The Faculty offers two undergraduate programs, one extends over three years and is attended by the vast majority of the students, and the other takes four years to conclude. The Committee understood that most students cannot finish the three years study program on time, and is under the impression that this program has too many courses and is too structured. The Committee believes that more freedom to choose courses and assignments could benefit the students by opening exploration in related fields.

In addition to mathematics students, the Faculty is in charge of teaching service courses to about 13,500 Technion students. This charge is achieved through a mix of Faculty teaching combined with a large number of external teachers. The Committee has been impressed by the efficiency and high quality of the service courses, and in particular by the competence and dedication of the adjunct teachers.

The challenges of teaching and grading such a varied community of students are daunting. The Committee has been impressed by the team effort of administrating staff, instructors and IT personnel, to come out with creative solutions, such as the on-line MathNet grading system for the different large classes, as well as an on going effort of tailoring course material to the needs of various student groups. Nevertheless, the Committee noted that the compensation for grading is not sufficient, resulting in students seeking employment elsewhere or not having the time to pursue their studies.

Obvious problems arise because of the large number of adjunct teachers whose course load vary and have no consistent employment. The teaching could be further enhanced by providing some special status to the best teachers (as we recommend below).

The student body of both undergraduate and graduate students is well treated and enthusiastic about their learning experience and open-door policy of the academic and administrative staff. However, they also reported that classrooms are crowded. The Committee was under the impression that the students could not afford the time for exploration of related disciplines because of a heavy curricular load, nor did they interact much with students and faculty from other Universities. This point is particularly important as students tended to perform all of their academic studies in the same institution, and might end up with an insular view.

Research

The research activity of the Faculty is strong. It covers a broad range of major areas in pure and applied mathematics. Recently the Faculty has hired several outstanding young mathematicians, resulting in a dynamic research environment. As evidence to the quality of this research, we refer to the number of publications in top journals and to the level and number of research grants in the Faculty. In addition, collaborations with other mathematicians on campus, including research and consulting activity with scientists from other disciplines and industry, are also occurring.

The Committee felt, however, that the level of research interactions with other departments both within the university and with other mathematics departments in

Israel could be substantially enhanced through the development of joint seminars and community building activities, both internally in the Technion and in Israel at large. In particular collaboration with the University of Haifa involving joint cross listed courses could be of great benefit to both departments.

Such broadening of horizons would be particularly beneficial to the graduate students, some of whom expressed a sense of isolation. This kind of interactions is particularly needed as most of the graduate students we met had also done their undergraduate studies at the Technion.

The area of applied mathematics poses a special challenge. This field has expanded dramatically over the last decade with mathematics permeating most human activity, from biology to document search, computational knowledge, economics, the social sciences and the humanities. Moreover, the range of areas within pure mathematics that contribute to this rapidly expanding activity has broadened considerably, from analysis to differential geometry, number theory, logic, algebraic geometry and many others areas which once seemed too pure to be applied. The Faculty has recognized that it needs to build up in this area and has broadened its definition of an “applied mathematician” to include colleagues who are engaged in mathematical work outside pure mathematics (going substantially beyond the conventional focus of applied mathematics as providing computational simulation/modeling and analysis tools).

Infrastructure

The facilities are excellent in general. Our main recommendations for enhancement are to extend the hours of operation of the Mathematics Library (which are minimal); to provide more office space (as the faculty are currently crowded); and to provide more functional large mathematics classrooms (in particular more Black/White board surfaces are needed).

Summary and Recommendations

The leadership in the Faculty is excellent, and over the last years the Chair has already initiated action on many of our recommendations. There is a collegial atmosphere in the Faculty, and a good working relationship with the administration. The erosion of faculty size has stopped, and with the hiring of new young and dynamic faculty members we see a definite improvement in the scope and quality of the Faculty. This

is a critical period for the Faculty, in view of the rapidly expanding role of mathematics in various fields of applications beyond the physical sciences, including informatics, machine learning, medicine, economics and the social sciences. The Committee welcomes the initiatives of the Faculty in recruiting outstanding faculty members in applied mathematics.

The Committee recommends as follows:

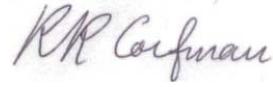
1. To enhance the range of interaction with other departments, both within the Technion and at universities in Israel. This aim can be achieved by expanding the number of joint seminars, a rotating visitor program and community building efforts, especially among the PhD students. The interdisciplinary program in applied mathematics is a good foundation for internal growth. In particular the presence in Haifa of two universities with complementary character, the University of Haifa with main emphasis on Humanities and Technion with its emphasis on Engineering and Natural Sciences, offers the possibility of cooperation not present elsewhere. The committee emphasizes the great advantages to both sides that such an alliance can offer, in particular to the two departments of mathematics.
2. The Faculty provides massive teaching services to the Technion, and has done a remarkable job in streamlining the process through the introduction of innovative management and teaching methods, which already implement some of the recommendations below. In particular, the Faculty introduced an online grading program, MathNet, which substantially alleviates the grading load. We strongly recommend the continuing enhancement and development of this teaching tool, that we feel could be adopted by all mathematics departments in Israel facing a similar challenge. The Committee also recommends further tailoring of the various service courses to the specific needs of various groups of students; this will permit more efficient use of teaching time.
3. The adjuncts teaching the service courses are very competent and dedicated; we recommend that their employment situation be stabilized, and in particular that the top teachers be given stable multiyear employment contracts.

4. As most students spend their whole learning track at the Technion, their exposure to the world is somewhat insular. Ideally, students who get their undergraduate degree would go to another institution for their graduate degree. The Committee recommends that an effort be made to expand the range of interactions of both students and faculty through joint inter university rotating seminars, multi university summer schools for graduate students and other community building activities.
5. We recommend a vigorous effort in recruiting outstanding applied mathematicians, defined broadly to cover the full spectrum of current and future relations between mathematics and the world. Closer links to the community of users of mathematics on campus would enhance this effort.
6. The three years course study program has too many courses and is too structured. A little more creative learning and less mandatory courses would provide more freedom to choose courses and assignments, as well as broader vistas.
7. Library hours are too limited. The library is an essential working laboratory for mathematics students and faculty. Ideally it should be accessible at all hours.
8. The compensation for grading is not sufficient, resulting in students seeking employment elsewhere or not having the time to pursue their studies.

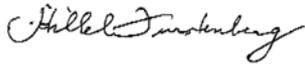
Signed by:



Prof. Benedict Gross, Chair



Prof. Ronald Coifman



Prof. Hillel Furstenberg



Prof. Gerard van Geer



Prof. David Jerison



Prof. Yakar Kannai

Appendices

Appendix I- Copy of Letter of Appointment



December 12, 2009

Prof. Benedict H. Gross
Mathematics Department
Harvard University
USA

שר החינוך
Minister of Education
وزير التربية والتعليم

Dear Professor Gross,

The State of Israel undertook an ambitious project when the Israeli Council for Higher Education (CHE) established a quality assessment and assurance system for Israeli higher education. Its stated goals are: to enhance and ensure the quality of academic studies; to provide the public with information regarding the quality of study programs in institutions of higher education throughout Israel; and to ensure the continued integration of the Israeli system of higher education in the international academic arena. Involvement of world-renowned academicians in this process is essential.

This most important initiative reaches out to scientists in the international arena in a national effort to meet the critical challenges that confront the Israeli higher educational system today. The formulation of international evaluation committees represents an opportunity to express our common sense of concern and to assess the current and future status of education in the 21st century and beyond. It also establishes a structure for an ongoing consultative process among scientists around the globe on common academic dilemmas and prospects.

I therefore deeply appreciate your willingness to join us in this crucial endeavor.

It is with great pleasure that I hereby appoint you to serve as the Chair of the Council for Higher Education's Committee for the Evaluation of Mathematics Studies.

The composition of the Committee will be as follows: Prof. Benedict H. Gross – Chair, Prof. Ronald Coifman, Prof. Hillel Furstenberg, Prof. Gerard van der Geer, Prof. David Jerison, Prof. Yakar Kannai. Ms. Noa Nof-Steiner will coordinate the Committee's activities.

In your capacity as the Chair of the Evaluation Committee, you will be requested to function in accordance with the enclosed appendix.

I wish you much success in your role as the Chair of this most important committee.

Yours sincerely,

Gideon Sa'ar
Minister of Education,
Chairperson, the Council for Higher Education

Enclosures: Appendix to the Appointment Letter of Evaluation Committees

cc: Ms. Riki Mendelzvaig, Secretary of the Council for Higher Education
Ms. Michal Neumann, Head of the Quality Assessment Unit
Ms. Noa Nof-Steiner, Committee Coordinator

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Appendix 2- Site Visit Schedule

**The Committee for the Evaluation of Mathematics Study Programs -
Schedule for the visit at the Technion Mathematics Department
Amado Building, (room 800)**

Wednesday Jan 13, 2010

Time	Subject	Participants
09:30-10:15	Opening Session: The heads of the institution and department	President -Prof. Peretz Lavie Senior Executive VP -Prof. Paul Feigin Deputy Senior VP - Prof. Moshe Sheintuch Dean of Graduate School- Prof. Moshe Shpitalni Dean of Undergraduate Studies - Prof. Yaacov Mamane Dean: Jacob Rubinstein
10:15-11:30	Meeting with the academic head of the department	Jacob Rubinstein
11:30-12:30	Meeting with senior faculty and representatives of relevant committees (teaching/curriculum committee, admissions committee, appointment committee)	Yoav Benyamini, Itai Shafrir, Eddy Meyer-Wolf, David Chillag, Ron Holzman(G),
12:30 -13:15	Lunch	Jacob Rubinstein, Ross Pinsky, Yoav Moriah, Yehuda Pinchover
13:15-13:45	Tour of campus (classes, library, offices of faculty members, computer labs etc.)	Baruch Solel, Ruti Markevich
13:45-14:30	Closed-door working meeting of the committee	

Thursday Jan 14, 2010

Time	Subject	Participants
09:00-09:30	Meeting with adjunct teachers	Naomi Shaked, Aliza Malek, Assaf Hari, Aga Nader, Tiferet Saadon, Nathan Wallach
09:30-10:15	Meeting with young faculty members	Rom Pinchasi, Tamar Ziegler, Micah Sageev, Udi Yariv, Shlomi Gelaki, Uri Bader
10:15-11:15	Meeting with undergraduate students	Zohar Shapira, Reut Zuck, Hagay Shacham Ami Paz, Maxim Gurevich, Nethanella Messer, Ben Herzog, Tal Knafo
11:15-12:15	Meeting with graduate students and junior academic staff	Adi Wolf, Mohammad Abu Hamed, Or Beit-Aharon, Tali Pinsky, Sedi Bartz, Daniel Baffet, Nitay Arcusin, Natan Fridland
12:15-12:45	Meeting with administrative staff	Ruti Markevich, Racheli Toboul, Hanna Kaplan, Michal Gotlieb
12:45-13:45	Lunch and Closed-door working meeting of the committee	Light lunch at the meeting room
13:45-14:30	Summation meeting with head of the department	Jacob Rubinstein
14:30-15:15	Summation meeting with heads of the institution and of the department	President -Prof. Peretz Lavie Senior Executive VP -Prof. Paul Feigin Deputy Senior VP - Prof. Moshe Sheintuch Dean of Graduate School- Prof. Moshe Shpitalni Dean of Undergraduate Studies - Prof. Yaacov Mamane Dean: Jacob Rubinstein