THE DEVELOPMENT OF GENE 101 – A ‘STRATEGIES AND SKILLS FOR ACADEMIC SUCCESS’ COURSE FOR FIRST YEAR ENGINEERING STUDENTS AT WATERLOO

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Abstract – As a way to help ease the struggles that students face in the transition from high school into university, the Engineering Faculty at the University of Waterloo started a reduced load program in 2010. During their first term at Waterloo, engineering students who are in academic jeopardy after midterms can drop two prescribed courses to give the students an opportunity to finish the term on a successful note. The two dropped courses are taken during the following spring term along with a third course, GENE 101 – Strategies and Skills for Academic Success. After successfully completing the reduced load terms, the students return to a full load. GENE 101 is considered a foundational success course. This paper will look at the curriculum and structure of the course and the impact it has had on engineering students. At the time of this writing, two groups of students who took GENE 101 and the reduced load program have graduated from Waterloo as engineers.

Keywords: Academic Success, foundation term, academic strategies and skills

1. INTRODUCTION (INCLUDING LITERATURE)

Not all students are able to successfully transition from high school to university: the increase in workload is difficult for students who lack time management skills; course content is delivered at an accelerated pace; and assessments, in the form of midterms and final exams, are perceived as high-pressure [1, 2]. In addition, the difficulty of the material in engineering courses demands an understanding of the concepts in order to apply the material. Those students who rely on memorization tend to struggle, particularly when the exam questions are not identical to what they memorized. The objective of GENE 101 is to promote successful independent learning. This is accomplished by addressing the reasons that students struggle in the first place: transitional issues, academic difficulty, and the perception of not belonging [3]. In order to address these issues, the GENE 101 curriculum includes self-awareness, personal wellness, personalized learning in the form of academic skills, and professional growth.

In order to adapt to the post-secondary environment, it is often necessary for students to employ new academic and coping skills in order to adapt to the post-secondary environment. Students who struggle to acquire, or are slow to implement, these new skills may see a negative effect on their grades. In particular, a study by Kerka [4], cited by Kinder et al. [5], found that the frustrations students feel from the lack of information received regarding the increased demand and workload at the post-secondary level affect their academic success. Additionally, students are more likely to leave university if they have been placed on probation after their first year [6]. Research suggests that early intervention is the key to retaining these “at-risk” students [7] and that of these students, those who participate in learning skills seminars have, on average, higher grades and are less likely to be put on academic probation than those students who choose not to participate [8]. As a result, many Canadian and American post-secondary institutions have incorporated student success programs, typically referred to as University 101 courses, in order to support this transition and to increase the likelihood of students achieving “success”. When this type of support program is effectively delivered, significant improvements in student performance and persistence are realized [9]. Additionally, although many students enter post-secondary education academically unprepared, they are still “malleable to institutional intervention” [10], making these types of programs appealing to institutions seeking strategic interventions that support student success as well as improving retention. As such, the goals of many student success programs are to develop academic skills, to help students integrate both academically and socially to post-secondary education, and to help students find balance through involvement in other aspects of the institution [11]. In particular, Gilbert [12] suggests that an emphasis on holistic student growth and development achieves better results than a focus on academic expertise.
Student success programs differ among institutions in a number of key characteristics, but what they all have in common is the dialogue with students about what they can do to help themselves reach their academic goals [9]. The following is a brief description of the common best practices implemented in student success courses.

Course Curriculum: Teaching students academic skills, information literacy skills, as well as connecting students to peers and encouraging students to develop personal and educational goals, improves retention rates [5]. Out of institutions that responded to the 2006 National Survey of First Year Seminars [13], most stated that the priorities of their student success courses was the development of academic skills in their students (64.2%), as well as orienting students to campus resources and services (52.9%). Additionally, the survey found that study skills (40.8%), critical thinking (40.6%), campus resources (38.1%), academic planning/advising (36.7%), and time management (28.6%) were the most important topics in the seminars.

Course Structure: Student success courses are typically delivered in small group settings, which allow for small-group discussions, as well as allowing instructors the ability to tailor content and discussions to the students' particular needs, and to incorporate experiential learning activities. According to the 2006 National Survey of First Year Seminars [13], the majority of responding institutions indicated that their success courses typically ran for one semester and had enrollment of between 10 to 25 students per section. The survey also indicated that the majority of institutions granted credit for the course (92.2%), with most institutions (82%) granting a letter grade. Kinder et al. [5] advocate for 45-48 contact hours, per term, in these types of courses, indicating that courses with one semester hour (16 total contact hours) severely impedes the quality and quantity of the instruction.

Eligible Students: Eligibility for participation in student success courses varies across institutions, with some institutions restricting access to first year students only. Others, such as the University of South Carolina, host programs for each of the four undergraduate years.

Instructors: The 2006 National Survey of First Year Seminars [13] found most institutions use faculty to teach student success courses with more than half employing a co-teaching model with student affairs professionals.

Course Assessment: A majority of institutions report assessment of their success courses, with “student satisfaction” being the most frequently measured outcome, followed by second-year retention numbers, student satisfaction with the institution, and use of campus services [11].

A number of Canadian universities offer University 101-type courses. The University of Prince Edward Island [14] offers a ten-week student success course that focuses on developing study skills, identifying learning styles, and connecting students to peers and campus services. The course is open to students from all faculties with enrolment limited to 25 students to increase student engagement and facilitate small group discussions. Students can register for the course voluntarily or be referred as a condition of their academic probation. Kinder et al. [5], citing Gilbert et al. [12], indicates a significantly higher retention rate for students enrolled in this program (86%) versus those who do not enroll (60.7%), based on the results of a nine-year program evaluation.

The University of Toronto, Mississauga [15] offers a number of student success courses aimed at supporting the transition to university. The courses focus on developing academic skills such as critical thinking, effective communications, and note taking. Lecture enrolment is limited to 55 students, and the course is weighted at 0.5 credits.

Nipissing University runs a UNIV 1011 course [16] for students enrolled in their first 30 credits (30 credits equals one year). The course is structured to run in one term with three lecture hours per week and is worth 3 credits. The objective of the course is to develop students’ academic, personal and social skills to promote success in the post-secondary environment. A number of topics are explored, including time management, reading, writing skills, and learning strategies.

The University of Northern British Columbia [17] offers a foundational course aimed at improving students’ academic performances across all of their courses. This 3 credit foundational course introduces students to university services, methods of academic inquiry, as well as opportunities to practice study skills and learning strategies.

One of the longest established University 101 programs is at the University of South Carolina [18]. A study of 2776 students over a seven year period have shown the following rates for course participants vs. non-participants: retention: 69% vs. 51%, graduation: 56% vs. 51%, and dropouts: 31% vs. 47% [19].

GENE 101 at the University of Waterloo was first offered in the spring of 2011 as part of the reduced load program. The course originally used guest lectures from Counselling Services, Health Services, to deliver content. Starting the following spring, 2012, GENE 101 was taught by an Engineering Faculty member and a staff member from the Student Success Office.

The next section of this paper presents the history of GENE 101, how the course fits in to the structure of the reduced load program, and the curriculum of GENE 101. Section 3 presents the success of GENE 101.

2. GENE 101 AND THE REDUCED LOAD PROGRAM

This section will discuss the origins of a “strategies and skills for academic success” course at the University of
These students are considered to have opted in to the two courses that were dropped along with GENE 101. The students who are successful in the fall term finish the second half of 1A in the following spring term, picking up and study time) that can be put towards their other courses. Dropping two courses reduces the students' workload and gives them approximately 20 hours back (course contact time). The objective is to finish and pass the term on and life balance recognizes that engineering is a heavy workload but the other parts of life cannot be neglected.

2.1. The origins of GENE 101

A First Year Task Force in the Engineering Faculty at the University of Waterloo identified the need for a strategies and skills for academic success course in order to support students during their transition from high school to university. At the same time Engineering was invited to join a committee of Associate Deans Undergraduate who were working with Health Services on the same topic.

The curriculum for a strategies and skills for academic success course emerged from efforts to understand the academic supports necessary for students working with psychologists and psychiatrists. In particular, a staff member in the Health Services department conducted research to explore how students challenges in mental wellness were affecting their pursuit of a university degree. Initial surveys of students working with mental health professionals were conducted in Fall 2008 and Winter 2009. A follow up, campus wide survey was administered in Fall 2010 to further understand what learning strategies and life skills could support students who were struggling to make behaviour change - both in their mental wellness, and academic success. Findings from these surveys suggested that students sought help to: improve their personal wellness; learn personalized learning approaches; grow in their professional skills; and ultimately, learn about themselves by becoming more self-aware of their strengths and challenges. Upon the completion of this research, a ‘Students in Academic Distress’ committee was formed to identify how these key skills could be integrated into the student experience. Included in the recommendations was the development of the curriculum for a ‘strategies and skills for academic success’ course.

2.2. The Structure of the Reduced Load Program

During the first term, known as 1A, in engineering at the University of Waterloo, students that are identified after midterms as being in academic jeopardy are invited to join the reduced load program. Two courses, generally Chemistry for Engineers and a choice between Calculus I or Linear Algebra, are dropped from their first term. Dropping two courses reduces the students’ workload and gives them approximately 20 hours back (course contact and study time) that can be put towards their other courses. The objective is to finish and pass the term on a good note. The students who are successful in the fall term finish the second half of 1A in the following spring term, picking up the two courses that were dropped along with GENE 101. These students are considered to have opted in to the Reduced Load Program (RLP).

Not every student decides to join the RLP but instead opt out of the RLP. Like the RLP, there will be a portion of the students who opt out and are successful in passing the term. These two groups of students who struggled academically and were able to pass their first term are compared to assess the effectiveness of the RLP. The RLP results in a higher retention and higher term averages with fewer students failing and repeating future terms.

2.3. The Curriculum of GENE 101

The curriculum for GENE 101 is divided into four different categories: personalized learning in the form of academic skills, self-awareness, personal wellness, and professional growth. These categories are further subdivided as shown in Figure 1. There is overlap in the categorization of the topics covered in GENE 101.

![Figure 1. GENE 101 curriculum concept map.](image)

Academic skills includes topics that are directly related to learning in lectures, self-learning, and studying in order to provide an understanding of how an individual learns. Students are supported in figuring out how they learn and what works best for them. Topics include reviewing the course syllabus, reading and note taking, test taking strategies, and problem solving. Learning and memory along with a lecture on how the brain works serves to explain why spending time solving problems is important to understanding the concept being taught and to understand how to apply the concept.

Self-awareness starts with values and goal settings with each student examining why they are studying engineering. Does an engineering degree line up with their long-term goals? Life balance recognizes that engineering is a heavy workload but the other parts of life cannot be neglected. Concentration and procrastination is included with academic skills, though could belong under personal wellness or self-awareness.

An individual’s personality type has been shown to have an impact on academic success [20]. Learning and teaching styles are also covered and the lecture on resiliency serves to show students that everyone fails at something and that being able to bounce back is important.
Personal wellness includes topics related to mental and physical health. Having never faced the possibility of failing before, some students lack the coping skills to manage stress and stay focused on their goals. Stress management includes the understanding and management of stress, dealing with test anxiety, and coping skills. Coping skills are the understanding of thoughts and negative thought patterns, understanding emotions and how emotions can be influenced by thoughts, and changing behaviour so that a negative thought pattern does not spiral out of control. Sleep is critical for the mind and body to function at a high level along with health and nutrition. Addiction and avoidance, originally requested by students in GENE 101, along with depression are also covered. A fixed or growth mindset is categorized under personal wellness, though it could also belong under academic skills or self-awareness.

Professional growth includes communication skills in the form of technical report writing and presentation skills. Working in multi-disciplinary groups is facilitated with an engineering design project. Time management covers the spectrum of daily, weekly, and monthly planning with the latter being extended to the four-month term. Scheduling time for exam preparation and estimating how much time is needed for each course is also included.

The order in which the various topics were covered in the term, shown in Table 1, was determined based on what the authors thought were the most important for engineering students. In general, most topics have been delivered at the same time in the term from year to year.

Table 1. Timing of GENE 101 curriculum delivery.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Course syllabus, reading &amp; note taking, values and goal setting</td>
</tr>
<tr>
<td>2</td>
<td>Time management, stress management</td>
</tr>
<tr>
<td>3</td>
<td>Learning &amp; memory, problem solving, personality type</td>
</tr>
<tr>
<td>4</td>
<td>The brain, thinking, emotions, behaviour</td>
</tr>
<tr>
<td>5</td>
<td>Sleep, addiction &amp; avoidance, concentration &amp; procrastination, time management for exam preparation</td>
</tr>
<tr>
<td>6</td>
<td>Growth &amp; fixed mindset, test taking strategies, test anxiety</td>
</tr>
<tr>
<td>7</td>
<td>Midterms</td>
</tr>
<tr>
<td>8</td>
<td>Information credibility &amp; referencing, depression, life balance</td>
</tr>
</tbody>
</table>

Figure 2 show those topics that have been moved around based on class feedback and the instructors’ perspective on what worked and what did not work. Reading and note taking were moved from the fifth week of the term to the first week. Problem solving was shifted to a week earlier and learning and memory converged to the same week as problem solving. The topic on personality type is delivered as a “choose your own adventure” group activity and has moved from early in the term to late in the term and has now settled into an early term activity. As a group activity it can serve as an ice breaker, which is not required later in the term. Learning styles and teaching styles has usually been delivered during the same week as personality types.

2.4. Assessment of GENE 101 Students

Scheduling self-efficacy is affected not necessarily by the task itself that has to be coped with, but instead, by the environmental or situational variables that interfere with the plan to complete the task [21]. Students who face academic challenges need high levels of task, coping and scheduling self-efficacy for success. When the learning ends, structured self-efficacy, which throughout the seminar was a controlled variable, becomes independent. Students must begin to schedule their own tasks, time manage effectively, and efficiently navigate other environmental and situational variables that may arise. In light of this research, the assessments and curriculum in
GENE 101 were designed to support students in their behaviour change.

There are multiple deliverables for GENE 101. This section will report on four weekly deliverables: attendance, ongoing e-portfolio, lecture review notes, and time management. The objective is to spend twelve weeks reinforcing good habits so that the students will continue with these good habits in future terms.

It has been the authors’ observation that students who struggle tend to skip lectures and lack time management skills. To this end, a portion of their mark is based on attendance.

Time management deliverables are required weekly. Each week students are to submit a proposed schedule for the week and a comparison of what was proposed for the previous week and what they really did. At the beginning of the term a schedule for the entire term is to be submitted as well. As midterms and final exams are approached, the weekly time management deliverable has to show a study plan for exams. Not everyone wants to schedule themselves by the hour so other approaches are acceptable as well; for example, maintaining an agenda or a daily and weekly task list.

A key part of the study cycle [1] is reviewing lecture notes at the end of each day. To this end, students are required to hand in a summary of their lecture notes once per week. Again, over a twelve-week period, the objective is to establish good habits that will continue on for future terms.

3. THE SUCCESS OF GENE 101

GENE 101 has had a positive impact on the students who opt in to the reduced load program after fall midterms. Retention for RLP students is higher and their term averages are higher compared to students who opt out of the reduced load program.

The continued success rate of RLP students and those who decide not to take the RLP is shown in Table 2. From 2011 to 2017 the success rate for the RLP is 93% compared to 86% for students who opted not to take the RLP. For the students who opted in to the RLP, 2.5% failed and repeated a future term while 14% of the students who opted out of the RLP failed and repeated a future term.

Considering that most failures occur prior to 2B, looking at 2011 to 2013 to focus on students who have graduated or will graduate this year, the success rate for the RLP is 89% compared to 85% for students who opted out of the RLP. For the RLP students, 3.7% failed and repeated a future term while 17.6% of the students who opted out of the RLP failed and repeated a future term.

The students who have not found success in engineering have left the program or, at the time of writing, are waiting to repeat a failed term. A student is considered to be successful if they continue to progress through engineering and eventually graduate with an engineering degree. It is recognized that students realize they do not want to study engineering and they leave the program to do other things. This, from an individual student’s perspective, can be considered success even though it is not captured in the results.

The term averages for RLP students tends to be higher compared to those who opt out, though the averages converge towards the latter part of the degree. Figure 3 shows the differences between the two averages for each academic term (RLP term average – opt out term average). At the University of Waterloo, each year is divided into an A term and B term, resulting in 1A, 1B, 2A, 2B, and so on. The vertical bars are the 95% confidence interval for the differences [22]. If the RLP average is always higher than the opt out average, then the lower bound for the difference should be above zero. It can be seen that the lower bounds for the 3B and 4B terms drop below zero, indicating that the two groups of students can perform on par with each other. In the other terms, RLP students tend to have a higher average.
4. CONCLUSIONS

In conclusion, the Reduced Load Program is a retention initiative at the University of Waterloo. This initiative has been offered to ‘at-risk’ students since 2010. Students in the Reduced Load Program take two first year Engineering courses and GENE 101. The goal of GENE 101 is to help students become successful independent learners by supporting them in their behavior change. The curriculum supports this behavior change through the development of their academic and life skills, and models learning strategies for students who struggle to meet the demands of university level courses.

In general, the reduced load program has been an effective retention initiative for ‘at-risk’ students in Engineering. It provides self-awareness to students on their goals, improves their intrinsic motivation, as well as enabling them to implement academic strategies that will help them to be successful.

References


[17] Student Success Initiative, UNBC Undergraduate Calendar, University of Northern British Columbia, Prince George, BC. Available as of April 30, 2018 from https://www.unbc.ca/calendar/undergraduate/ssi.


