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Re-Engineering General Education and the Impact on Undergraduate Technology Students

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Abstract

This research shares insights into the results of a three-year process of re-engineering general education at Brigham Young University-Hawaii (BYU-Hawaii), a private university, and the impact this change has conveyed to our students, curriculum, and faculty. The authors first describe the background of traditional general education, then describe the impetus for change. This is followed by a detailed explanation of the new general education program and the resulting impact on students, specifically those perusing degrees in computer science, information systems, and information technology.

Keywords: General Education, Modular GE, Re-engineering, Technology Majors

1. INTRODUCTION

The call for innovation in general education (GE) has resounded in the halls of academia many times over the past several decades. The roots of GE, however, go back several centuries. The common core content for Harvard, founded in 1636, used Plato's classical liberal arts outline from the trivium and quadrivium published in Plato's *Republic* (O'Banion, 2016). Reengineering GE is much like the process of creating a new software program. In software engineering the existing system is identified as the "as-is" system and the new or improved system is referred to as the "to-be" system (Dennis, Wixom, & Tegarden, 2015). "To-be" GE systems are constantly emerging and since Harvard's inception Plato's outline has served as the foundation for American colleges until democratized education splintered liberal education into multiple disciplines and specialties (O'Banion, 2016).

The goal of this paper is to outline a simple approach for reengineering GE to give students a higher level of autonomy, more choices on areas of study, and more combinations with those choices.

2. IMPETUS FOR CHANGE

Change in GE has been influenced by many factors, including a 1994 U.S. Presidential report on education that emphasized a set of college graduate skills 26 years ago (Adelman, 1994). A current evaluation of the same subject reveals that employers today want skills that are completely different (Bortz, 2020), see Table 1.

Adelman also reviews the 1979 U.S. Presidential report from the President's Commission on Foreign Language and International Studies, *Strength Through Wisdom*, and emphasizes the findings, namely that the most important areas of

study for a college graduate in 1994 was, in order: a global perspective, fluency in a second language, and finally, multicultural knowledge and experiences.

Bear in mind, that in 1979 the global economy and globalization was on the rise. Bortz attributes his information to the *Job Outlook 2020* survey performed by the National Association of Colleges and Employers (NACE), Table 1.

Ranking/%	College Graduate Skill
1/91.2%	Problem-solving skills
2/86.3%	Ability to work in a team
3/80.4%	Strong work ethic
4/79.4%	Analytical skills, critical thinkers
5/77.5%	Written communication skills
6/72.5%	Leadership skills
7/69.6%	Verbal communication skills
8/69.6%	Initiative
9/67.6%	Detail-oriented
10/65.7%	Technical skills
20/2.9%	Fluency in a foreign language

Table 1. Skills Employers Look for in New Grads, 2020

Employer expectations have felt a seismic shift. The first 10 skills were not on Adelman’s radar in 1994, and the number 1 skill 26 years ago now appears as number 20 with a current percentage of 2.9% (included in Table 1 for comparison).

Other skills, typically on the top 10 list in the past, have also fallen: interpersonal skills, organizational ability, tactfulness, and creativity used to be seen as workplace skills that would be taught in GE classes. Why? Because academic leadership typically does not want to give up precious time in their disciplinary majors and minors to teach interpersonal skills (Koritz, 2019).

The top 10 skills, sought after by employers, are no doubt a product of our global economy. Our ability to connect with each other, whether personally, or commercially in C2B, B2B, or B2G venues has vastly improved as broadband replaced antiquated dial-up speeds in systems employing fiber optic cable, satellites, microwave and more capable switches, routers, and servers.

Background in General

This remarkable acceleration of technology has outstripped the traditional education system. The overall accessibility of information precludes the need to memorize information (Rusetskii, 2014), the standard of past education systems.

Memorizing the U.S. Presidents, the capitals of each state in the U.S. or your own home country was a rite of passage for children. One of the authors of this work enjoyed an undergraduate humanities class in music and memorized the progress of Gregorian Chant to the early classics, but can’t remember the sequence now or other details of non-STEM GE course material.

Foundation courses essential to STEM majors begin with basic GE courses in mathematics and science (Stieha & Shadle, 2017). Although these basic courses make perfect sense to STEM educators and hopefully students, they may not make sense to other disciplines. The GE repertoire is obviously much broader than mathematics and science; Rusetskii also notes that the crises in GE is that the body of knowledge for any specialization has increased in size and complexity and may be obsolete next semester, or even tomorrow. His third point is one that educators grapple with every semester, what should be taught now for students to be successful in the 21st century? He also notes the following points:

- Education is losing its ability to empower students in providing upward social mobility.
- The three “R’s” no longer set up a person for success for the rest of their life as the world’s body of knowledge is rapidly changing daily.
- And finally, students at most levels, and especially the college level, expect autonomy in the educational process to follow their interests and personal goals.

The Environment

BYU–Hawaii has over 3,000 students, 50% of them international. Approximately 29% of students are in Science Programs (including Biochemistry, Biology, Chemistry, Exercise and Sport Science, Psychology, Physical Science Education, and Physics Education); 4% are in Computing and Mathematics (Computer Science, Information Systems, Information Technology, and Mathematics, applied, pure and educational). The remainder of students are in business, arts, and humanities. BYU–Hawaii doesn’t have the infrastructure for an engineering program, but does have robust programs in science, technology, and mathematics.

Benchmark GE Programs

Rusetskii's last point, autonomy, is the core driver of GE change at BYU-Hawaii. After many years of trying to tweak our GE program, the authors' university became aware of two new GE programs at other universities that provided a benchmark. Both the University of Rochester and The College of Idaho created GE curricula that simplified their GE programs as follows and let students make most of their own academic choices:

The University of Rochester created a simplified GE program with three basic parts (University of Rochester GE URL, 2020):

1. Primary writing requirement, mastery of written communication, with dozens of choices.
2. Course requirements for the major, three broad areas to choose: Humanities, Social Sciences, or Natural Sciences and Engineering.
3. Cluster in two other areas:
 - Politics and math
 - Sonic arts and technology
 - Power and inequality

The College of Idaho fashioned a similar approach requiring students to graduate with 1 major and 3 minors, in 4 years.

1. This program is called PEAK and offers 24 majors and 40 minors allowing students to pursue their "passion".
2. The categories, or "Peaks" include the humanities, social sciences, natural sciences, and a professional field.

3. GE MODULAR DEVELOPMENT

In June 2016 a Modular GE committee was led by a dean and formed of all department chairs, 17 educators, who had all experienced GE firsthand as students and teachers. Our charge was to "craft a proposal for a GE approach that can offer students both breadth and depth of education to help them be both more prepared and more marketable as they move beyond the University."

As this diverse group met each month for over a year, we discussed and crafted a new modular GE program that now has the name Holokai and was implemented Fall of 2018. Holokai, is a Hawaiian name meaning voyage, specifically: "Pacific Islanders sailed to new lands in voyaging canoes

using the stars and waves for navigation. The Hawaiians call this voyage Holokai. (kai = ocean, holo = to go, to move, to travel)." (Holokai website, 2020).

Two specific charges the committee was asked to address were student autonomy and allowing students to follow their passion.

Early in this process the authors were reminded that many of our students come to our university with a directive from their parents on what major they should pursue.

The new modular GE program, Holokai, allows a student the autonomy to select their own journey; they could still major in computer science for the family business, but they could follow their passion and select a minor in film and a minor in entrepreneurship, see Figure 1.

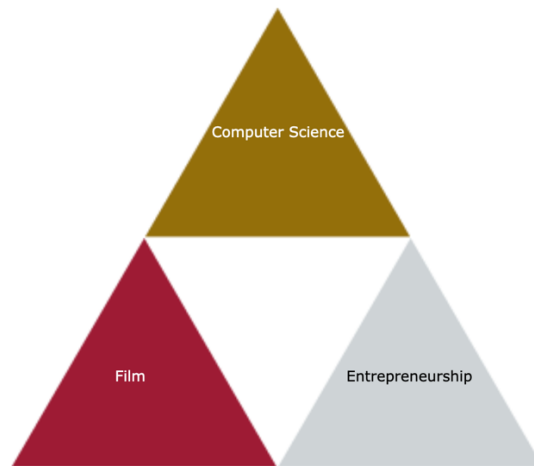


Figure 1. Sample Holokai

This graphic represents the majors, minors, and certificates in three categories:

- Crimson represents Arts & Humanities
- Gold signifies Math & Sciences
- Silver stands for Professional Studies
- The White triangle stands for the Religion, Math and English Core.

Details for each of these categories appear on the Holokai website, this also acts as an application that allows a student to graphically setup their plan (Figure 2 and 3 in the appendices shows the student website for creating a Holokai).

Before this significant GE change, the number of minors was very small in the technology area at BYU-Hawaii. Each major (CS, IS, and IT) had an *existing minor.

To meet the needs of many more students seeking options for minors under the Holokai, the Computer & Information Sciences Department created 10 new minors/certificates in the "Professional" and "Math and Sciences" categories. Our excitement to create these new options has not matched the expected traction, and those marked with a "^" may be suspended, Table 2.

Professional	Cr Hrs
- Agile Project Mgt Cert	15
- Digital Business Cert	14
- Digital Security Cert	18^
- Digital Security Minor	12^
- Digital Tech. Minor	18
- Enterprise Business Systems Minor	15
- Information Sys. Minor	18*
- Intro. to Digital Tech. Minor	12^
- Intro. to Mobile App Development Minor	12
- Intro. Web Des. Minor	12
Arts and Humanities	
- none	
Math and Sciences	
- Comp. Science Minor	18*
- Information Tech. Minor	18*
- Web Development Minor	18^

Table 2. Minors and Certificates Created for New GE Program

Another consideration that was a common discussion by the Modular GE Committee was what will happen to GE service courses currently part of the as-is GE Program? Time has proven that these courses were replaced or redesigned to meet the needs of the to-be GE Program with a zero-sum gain.

Another programmatic area of concern was the need to assure the students received both a depth and breadth of experience that was the impetus of previous traditional GE programs. This is inherently solved with the categories designed in the Holokai and the requirement that a student's major and two minors must be selected from different categories: Professional, Arts & Humanities, Math & Sciences, see Table 3 in the appendices for details.

All students are required to also complete 14 credit hours of religious education, selecting from 23 courses; students also are required to complete core classes in Math and English. The remainder of a student's academic program is

their choice, or their Holokai with the following core Math and English choices:

Mathematics-Quantitative and Logical Reasoning (3-5 credit hours required) allow the following choices:

- Statistics: MATH 121, BIOL 340, PSYC 205, POSC 300 & POSC 304, or EXS 339
- Calculus: MATH 212, MATH 213, or MATH 119.
- Trigonometry: MATH 111
- Quantitative Reasoning: MATH 107
- Discrete Mathematics: CIS 205

For Reading/Writing/Speaking, the following choices are provided to students:

- Reading/Writing/Speaking (6 credit hours required, 3 basic, 3 advanced).
- ENGL 101 Communication in Writing, Speaking, and Reading (3) and,
- Advanced Writing (3 credit hours).

The advanced writing requirement can be completed by taking one of the following: ENGL 314 Exposition and Analysis in the Humanities (3) or ENGL 315 Topics for Advanced Writing and Analysis (3) or ENGL 316 Technical Writing (3) or an Approved Senior Seminar in the major: CHEM 494, HIST 490, CS 491-493, IT 491-493

4. MOVING FORWARD

The University GE Program is in a transition period at this time. A resounding majority of students have chosen the new to-be Modular GE Program (Holokai) over the old as-is GE Program, 2,492 of 3,176 = 78% of our students.

Guiding Students on Their Holokai

BYU-Hawaii is staffed with an excellent cadre of 7 advisors who assist our students in all things related to their academic progress. This includes initial new student orientation and matriculation when the advisors help new students to create their academic plan. One advisor summarized the reasons why our students receive the Holokai with enthusiasm.

Why Students Choose the Holokai

The majority of students have embraced the Holokai Program due to the following reasons:

- They graduate with a minor or certificate that is beneficial for post-graduation and career goals and opportunities.

- Traditionally students had to take a prescribed set of general education requirements, now with the Holokai they have options with minors and certificates that allow them the breadth and depth to explore those minors and certificates to complement their learning and other ways of knowing based on their interest and personality.
- Students have a choice and a variety of different options for their education in the major they choose, and the minor/certificates span three disciplines: arts/humanities, math and sciences, and professional.
- This allows students a diverse set of choices in their chosen fields and to expand their vision and perspective of different areas and epistemologies.
- Additionally, students feel that when they graduate, they have the additional skill sets and knowledge which will potentially help them in the future workforce.
- Many of them will also complete additional minors and or certificates to increase their marketability, additional skills that will help them to successfully move beyond the university.

5. CONCLUSIONS

The new Holokai GE program empowers students with the autonomy they seek to control their academic studies which supports Rusetskii's premise that students prefer the ability to plan and pursue their own interests and personal goals.

The Holokai GE program also allows students to build a personal study program that provides breadth with a major and two minors in different categories: arts/humanities, math and sciences, and professional.

Students have shared with their academic advisors that they are very satisfied with the Holokai program. Each semester, lessons are learned and applied to improve the system, the courses, and the course offerings.

Concerns about losing programs, FTEs, or enrollment have been unfounded. In fact, in the technology area we have seen a steady enrollment increase of 7% per year for the past three years and are on mark to hire a new faculty FTE. Three adjuncts currently assist in teaching technology classes to meet the enrollment increases.

Planned future research and development activities include:

1. Formalize the process of gathering information from students about their Holokai experience, graduate surveys will likely be modified as our first group of students, who have experienced the Holokai from the beginning of their undergraduate program, graduate in 2020.
2. Continue to review and fine-tune minors and other programs to meet our ever-changing world of technology, information, and employer requirements.

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Appendices

Build Your Holokai

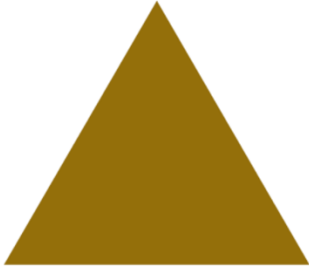
BYU-Hawaii offers majors, minors and certificates in three categories: Arts & Humanities, Math & Sciences, and Professional Studies. In order to earn a BYU-Hawaii degree, students must complete 120 credits and a combination of 1 major from 1 category and 2 minors/certificates (or additional majors if they fit within the 4-year allotment) from each of the remaining categories. The responsibility rests with the students to see that their programs of study satisfy all the requirements for graduation listed in the catalog. Advisors and other members of the faculty and staff will assist in any way possible.

If you use Google Chrome browser, please click the "CLEAR YOUR CHOICES" button before clicking on a triangle.


Click on one of the triangles below to start building your Holokai.



Arts & Humanities
Minor : Film



Math & Sciences
Major : Computer Science



Professional Studies
Minor : Entrepreneurship

Once you are satisfied with your choices, click on "BUILD YOUR HOLOKAI" to review your Holokai pyramid.

Figure 2: Student Tool, Build Your Holokai (Holokai Website)

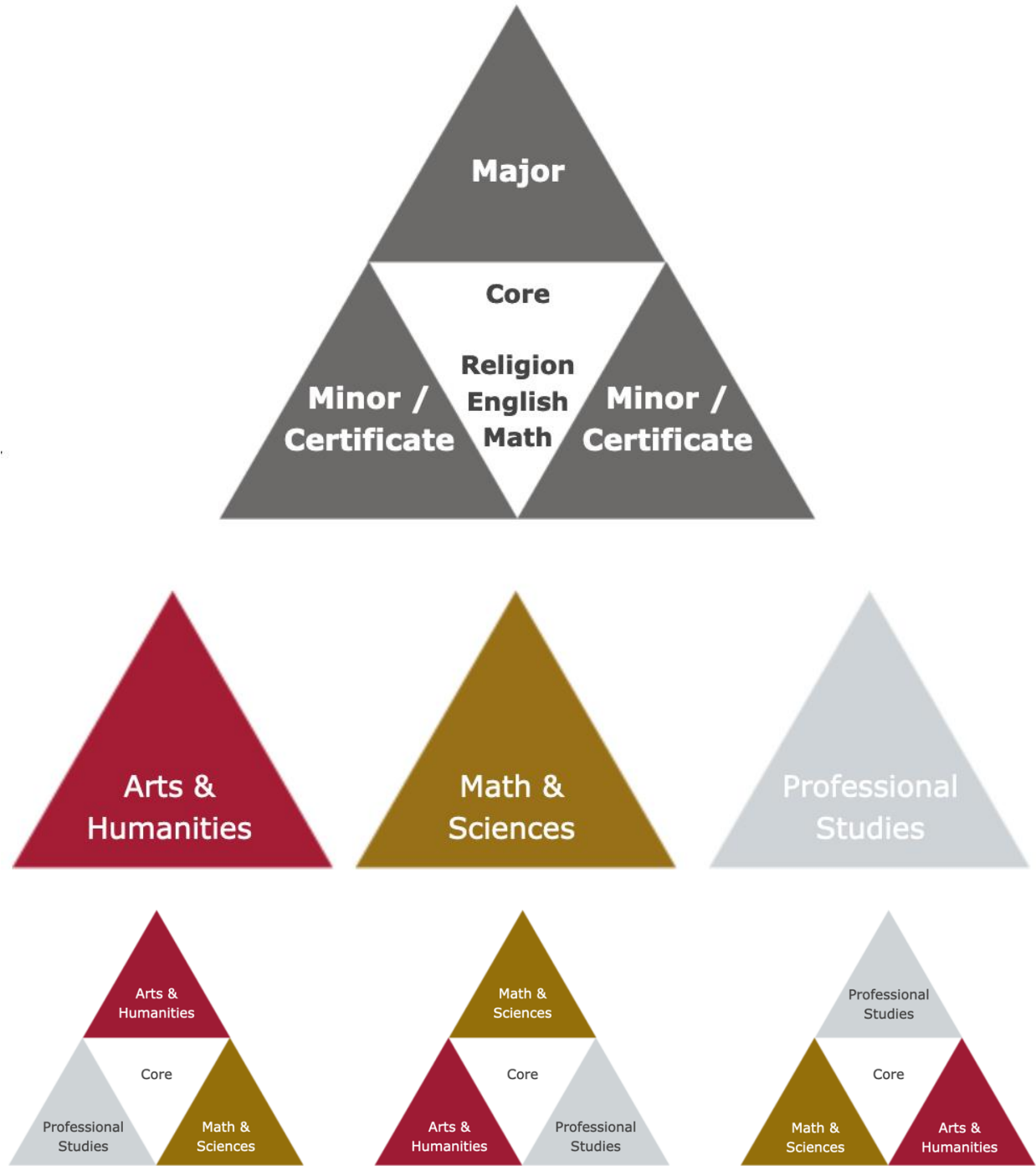


Figure 3: Holokai Category & Combinations (Holokai Website)

Arts & Humanities	Math & Sciences	Professional Studies
Art Education Major	Biochemistry Major	Accounting Major
Asian Studies Minor	Biochemistry Minor	Accounting Minor
Chinese Minor	Biochemistry Major – Environmental Science Emphasis	Agile Project Management Certificate
Communication Major	Biochemistry – Neuroscience Emphasis	Business Management Major – Economics
Communication Media & Culture Major	Biology Major	Business Management Major – Finance
Creative Writing Major	Biology Minor	Business Management Major – Human Resources & Org.
Cultural Anthropology Major	Biology Major – Ecol, Evol, & Pop	Business Management Major – Marketing
Cultural Anthropology Minor	Biology – Marine	Business Management Major – Supply Chain, Operations, and Analytics Concentration
English Minor	Biology – Molecular Biology	Coaching Minor
English Major – Creative Writing	Biology Education Major	Criminal Justice Certificate
English Major – Literature	Chemistry Minor	Digital Business Certificate
English Major – World Literature	Chemistry Education Major – US Teaching Certificate	Digital Security Certificate
English Major – Writing	Computer Science Major	Digital Security Minor
English Education Major	Computer Science Minor	Digital Technology Minor
Film Minor	Exercise & Sport Science Major – Biomedical Science	Economics Minor
Foundational Language Study Minor	Exercise & Sport Science Major – Health & Human Performance	Education Minor
Hawaiian Language Certificate	Exercise & Sport Science Major – Sports & Wellness Management	Elementary Education Major
Hawaiian Language Minor	Exercise & Sport Science Major – US Certification	Emergency Management Certificate
Hawaiian Studies Major	Health & Human Performance Minor	Enterprise Business Systems Minor
Hawaiian Studies Minor	Information Technology Major	Entrepreneurship Certificate
History Major	Information Technology Minor	Entrepreneurship Minor
History Minor	Intro Conservation Biology Minor	Governance Certificate
History Education Major	Intro to Chemistry Minor	Hospitality & Tourism Mgt Major
Integrated Humanities Major	Intro to Marine Biology Minor	Hospitality & Tourism Minor
Integrated Humanities Minor	Intro to Mathematics Minor	Human Resources Mgt Minor
Intercultural Peacebuilding Major	Intro to Natural Science Minor	Information Systems Major

Arts & Humanities	Math & Sciences	Professional Studies
Intro to Linguistics Minor	Intro to Nutritional Science Minor	Information Systems Minor
Japanese Minor	Intro to Physics Minor	Intercultural Peacebuilding Certificate
Linguistics Minor	Mathematics Minor	International Development Certificate
Music Minor	Mathematics Major – Applied Mathematics	Intro to Digital Technology Minor
Music Major – General Music	Mathematics Major – Pure Mathematics	Intro to Mobil App Development Minor
Music Major – Instrumental Performance	Mathematics Education Major	Intro to Social Work Minor
Music Major – Piano	Physical Science Education Major	Intro to Web Design Minor
Music Major – Vocal Performance	Physics Education Major	Intro to TESOL Minor
Music Major – World Music Studies	Political Science Major	Leadership Minor
Pacific Islands Studies Minor	Political Science Minor	Legal Studies Certificate
Pacific Islands Studies Major	Psychology Minor	Marketing Minor
Painting Minor	Psychology Major – Clinical/Counseling	Organizational Behavior Minor
Piano Performance Minor	Psychology Major – General/Experimental	Professional Writing Minor
Sculpture Minor		Public Management Minor
Spanish Minor		Social Work Major
TESOL Major		Social Work Minor
TESOL Education Major		Sports & Wellness Mgt Minor
Theatre Minor		Supply Chain, Operations & Analytics Minor
Visual Arts Minor		TESOL Certificate
Visual Arts Major – Visual Arts – Painting		
Visual Arts Major – Visual Arts Graphic Design		
Visual Arts BFA Major – VA Graphic Design BFA		
Visual Arts BFA Major – Visual Arts – Paint Fine Arts		

Table 3: Categories with majors/minors/certifications offered for the Holokai GE Program (Holokai Website)