Supporting Medical Innovation and Entrepreneurship through Curriculum-Integrated Information Literacy Instruction

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Outline

1. Why We Did This
2. What We Did
3. What We've Learned

Why We Did This

Research Engagement at NCSU Libraries

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“We promote, support, and deliver flexible modes of learning: integrated, deep domain targeted, and innovative instruction.”

Curriculum-Integrated Information Literacy

- Strategic approach for identifying high-impact instructional partnership opportunities
- Some of the criteria we consider:
 - Are the students completing inquiry-based assignments?
 - Is the course required for all students in the major?
 - Is the class high-throughput?

Nerz, H., & Bullard, L. (2006). The literate engineer: Infusing information literacy skills throughout an engineering curriculum. In *Proceedings of the 2006 American Society for Engineering Education Annual Conference & Exposition*.

Nerz, H. F., & Weiner, S. T. (2001). Information competencies: A strategic approach. In *Proceedings of the 2001 American Society for Engineering Annual Conference & Exposition. Session* (Vol. 2241). Retrieved from

http://depts.washington.edu/englib/eld/fulltext/00510_2001.pdf

Curriculum-Integrated Information Literacy

- Develop relationships with the instructors of these courses
- Engage in dialogue: what are your students struggling with?
 - Does the Libraries have expertise in that?
 - Can we develop it?

Curriculum-Integrated Information Literacy

- College of Engineering + College of Textiles:
 - FY2017: 60+ sections, over 3000 students
 - FY2016: 60+ sections, just under 3000 students
 - FY2015: 60+ sections, just under 3000 students
- Our instruction program is prolific, but are we sure it's any good?

What Makes “Good” Information
Literacy Instruction “Good”?

“Good” Information Literacy

- “Information literacy forms the basis for lifelong learning”¹
- For knowledge to be useful, it must be transferable²

¹Association of College & Research Libraries. (2000). *Information Literacy Competency Standards for Higher Education*. Retrieved from <http://www.ala.org/acrl/standards/informationliteracycompetency>

²Willingham, D. T. (2009). *Why don't students like school?: a cognitive scientist answers questions about how the mind works and what it means for the classroom*. San Francisco, CA: Jossey-Bass.

Are we empowering lifelong learning?

Is what we're teaching transferring?

What We Did

Biomedical Engineering (BME) Skills Gap

- Biomedical engineers routinely report feeling unprepared to enter the workforce¹
- “Once they settle into a new job, many of today's graduates soon discover that the techniques that may have worked so well for finding information when they were in college are no longer enough”²

¹Berglund, J. (2015). The Real World: BME graduates reflect on whether universities are providing adequate preparation for a career in industry. *IEEE Pulse*, 6(2), 46–49. <https://doi.org/10.1109/MPUL.2014.2386631>

²Head, A. J. (2012). *Learning Curve: How College Graduates Solve Information Problems Once They Join the Workplace* (Project Information Literacy Research Report). Retrieved from http://www.projectinfolit.org/uploads/2/7/5/4/27541717/pil_fall2012_workplacestudy_fullreport_revised.pdf

BME Design Sequence

BME 451 Biomedical Engineering Senior Design I

Units: 3

This course encompasses the project proposal and design concepts, including: individual pre-proposals, team proposals, project planning, scheduling, needs assessment, product requirements, competitive landscape and patent review, business risks, design concepts, and phase reviews. BME majors only.

Prerequisites: BME 302, BME 352, and completion of two of the suggested BME electives for their area of emphasis ; BME majors; Corequisites: ENG 331 or ENG 333

- Junior & Senior level design classes required for all BME students
- Students spend multiple semesters creating team-based design projects
- In their final projects, students teams:
 - define a problem
 - design a prototype
 - describe their device's marketability

Multidisciplinary Team

- NCSU Libraries
 - Alex Carroll
 - Shelby Hallman
- UNC / NC State Joint Department of BME
 - Dr. Andrew DiMeo (Instructor of Record)
 - Dr. Hatice Ozturk
 - James McCall
- NC State Department of Industrial Design
 - Prof. Kelly Umstead

Instructional Design

Course	Type of Information Source	Example Resource
Junior	Epidemiology	<i>CDC National Center for Health Statistics</i>
Junior	Peer-Reviewed Journal Articles	<i>PubMed</i>
Junior	Patent Literature	<i>Derwent Innovations Index</i>
Junior	Market Research and Business Intelligence	<i>Business Source Complete</i>
Senior	Legal Proceedings	<i>LexisNexis Academic</i>
Senior	Engineering Standards	<i>FDA Recognized Consensus Standards Database</i>
Senior	FDA Medical Device Regulations	<i>Recalls of Medical Devices Database</i>
Senior	Medical Device Billing and Reimbursement	<i>Principles of CPT® Coding</i>

Instructional Design

JOURNAL ARTICLES

PubMed

Includes over 21 million citations for biomedical articles back to 1947. These citations are from MEDLINE and additional life science journals.

Web of Science

An excellent resource of scholarly journal articles in pure and applied sciences, including medical journals.

Compendex

Compendex is the largest and most comprehensive engineering database. It provides references to articles in scholarly journals, trade journals and conference proceedings.

COMPANY, MARKET, & LEGAL INFORMATION

Business Source Complete

Use "company profiles" link off main page to read reports on selected companies.
Use "industry profiles" link off main page to read Datamonitor reports on selected industries

LexisNexis Academic

Using this database to search for legal proceedings or market information.

IBIS World

Detailed market research reports for every US industry sector.

PATENTS & STANDARDS

Derwent Innovations Index

This resource contains information on 14.8 million patents from US and international patent granting agencies.

FDA Medical Device Standards

Finding Standards @ NCSU

A guide to finding engineering standards.

FDA REGULATORY INFORMATION

Get help via phone, IM, or email.

Available

Librarian Chat

Type here to chat. Press ENTER to send.

Study Design

Control (2014-2016)
n = 5 (~35 students)

Content:
Traditional
Info Lit Curriculum

Delivery Medium:
Guest Lecture in
Senior Design

Phase I (2017)
n = 5 (~35 students)

Content:
Updated
Info Lit Curriculum

Delivery Medium:
Guest Lecture in Junior
Design and Senior Design

Phase II (2018)
n = 7 (~49 students)

Content:
Updated
Info Lit Curriculum

Delivery Medium:
Guest Lecture in Junior
Design and Senior Design
+
Hands-on Workshop in
Senior Design

Assessment

- Rubric Assessment of Final Design Documentation
 1. Justifies the problem addressed by explaining the impact on potential users and clinical care
 2. Evaluates the design concepts for market potential, economic feasibility, and patentability
 3. Designs the product as a creative response to a need
 4. Applies engineering knowledge and skills to build a working prototype

Assessment

BME Senior Design DEBUT Rubric

Team Name: _____

DEBUT Criteria	Skill Set	Score			
		Exceptional (9-10 points)	Satisfactory (6-8 points)	Emerging (4-5 points)	Benchmark (0-3 points)
Does the entry address an important problem or a critical barrier to progress in clinical care or research?	Justifies the problem addressed by explaining the impact on potential users and clinical care.				
How likely is it that the entry will exert a sustained, powerful influence on the problem and medical field addressed?	Evaluates the design concepts for market potential, economic feasibility, and patentability.				
Does the entry utilize novel theoretical concepts, approaches or methodologies, or instrumentation?	Designs the product as a creative response to a need, the functionality of which is driven by people.				
Has evidence been provided (in the form of results, graphs, photographs, films, etc.) that a working prototype has been achieved?	Applies engineering knowledge and skills to build a working prototype.				

Total Points: _____

Results: Rubric Evaluation

Results: Rubric Evaluation

Total Score

* $p=0.0133$

Results: Rubric Assessment

Criteria 2

* $p=0.0157$

“Evaluate the design concepts for market potential, economic feasibility, and patentability.”

Results: Citation Analysis

GROUP	AVERAGE TOTAL SCORE	AVERAGE SOURCES CITED	STANDARD DEVIATION	RANGE
CONTROL (n=5)	25.3	8	5.8	13
PHASE I (n=5)	31.3	7.8	9.0	22
PHASE II (n=7)	29.1	6.4	2.6	7
PHASE I + PHASE II (n = 12)	30.0	7.0	5.8	22

What We've Learned

Everyone should teach students about
the medical entrepreneurship life-cycle!

Just kidding.

Program Evaluation Design

Target a large
population...

Created by Wilson Joseph
from Noun Project

...or go long(itudinal)!

Created by Francisco Garcia Gallegos
from Noun Project

The Value of Authentic Assessment

Created by Bernar Novalyi
from Noun Project

Assessment as Relationship Building

A Seat at the Table

Created by Calcen
from Noun Project

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- James McCall
- Kelly Umstead

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Questions and Discussion

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These Slides: <http://go.ncsu.edu/acshtrln18>

OSF Project Page: <https://osf.io/bgr9f/>