



School of Informatics and Computing

Implementing Guided Inquiry Learning and Measuring Engagement using an Electronic Health Record System in an Online Setting

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Background

- There has been a **robust growth of online education** in last 13 years.
- No. of students enrolling in online courses reached to 5.8 million in 2016.
- However, only few academic leaders have expressed that online education is critical for long term strategies. **Drop from 70.8% to 63.3%**. Also, MOOCs (Massive Open Online Courses) have become more popular.
- It has been observed that students enrolled in online courses are **less engaged** than students attending face-to-face classes.
- Transfer of knowledge and competence building is hard to achieve, especially in technology oriented fields.
- Hands on training (e.g. lab sessions) is not easily available to online students.



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Project Context

- HIM undergraduate program (67th year) in IUPUI is a fully online program
- It needs to transfer technical competencies to its students. Therefore HIM is changing from record-keeping/clerical to more informatics-like program.
- For this purpose, a multitude of online engagement techniques like team-based learning and active learning strategies using virtual labs have been employed
- However, low engagement and lack of skills were observed amongst these students when they enroll into graduate education (health informatics program). We also have an accelerated 4+1 degree.



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Project Objectives

- To solve the challenge of engaging students in an online setting, in interdisciplinary field like HIM, we designed a novel monitoring tool- '**Student Team Based Learning Monitor**' (STLM)
- This was built on an open source electronic health record system – OpenMRS.
- **Long term objective:** Since physicians are spending 52% of their time recording, retrieving and managing data (Desktop Medicine). Improving engagement level of users in a clinical setting is also necessary.
- By introducing this tool we would measure engagement and thereby improve over the gaps that were determined, first in an academic setting and then in clinical setting.



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Engaged Learning Approaches

Discipline Based Education Research report (DBER) was developed by National Research Council, funded by the NSF to understand and improve learning in undergrad science and engineering courses. **Key findings** of DBER report:

1. **Involve undergraduate students in the learning process**
2. Students have incorrect understanding of concepts that are too large to observe
3. Students feel difficulty in understanding the important aspects of domains that seem simple to experts

To **improve the involvement of students** multiple approaches have been tried:

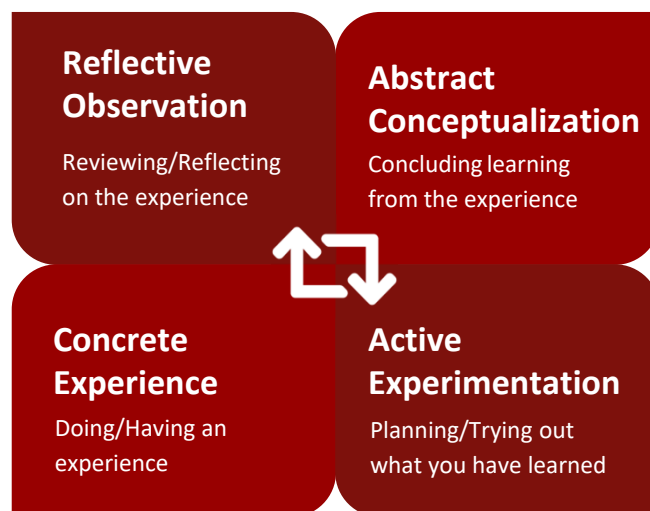
- Activity Learning
- Problem-based Learning
- Experiential Learning
- Inquiry Learning



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Experiential Learning

- Requires self initiative, an intention to learn and active phase of learning.
- Drawback: can not be applied in undergrad and online due to self initiative aspect, which is hard to achieve.



KOLB's experiential learning cycle

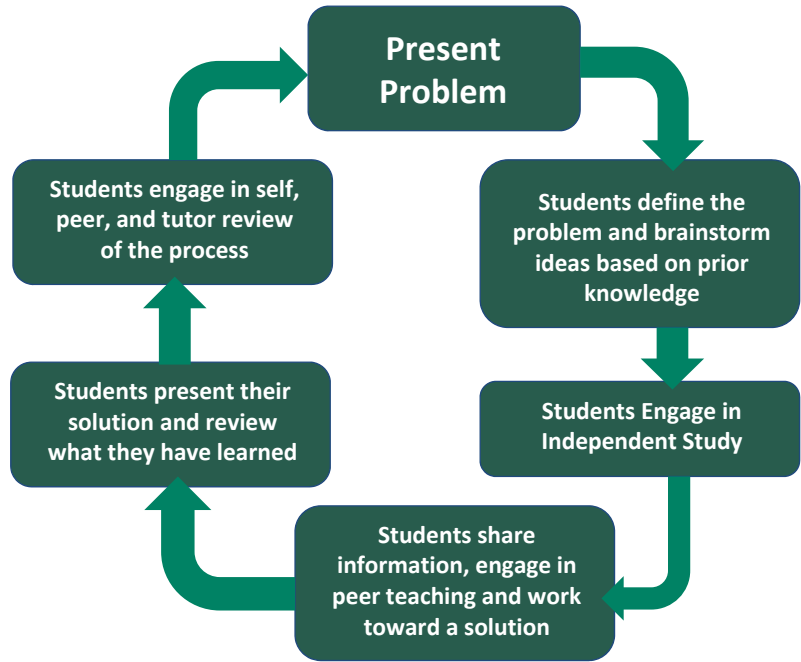


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○ <https://learningck.wordpress.com/tag/kolb/>

Problem-based Learning

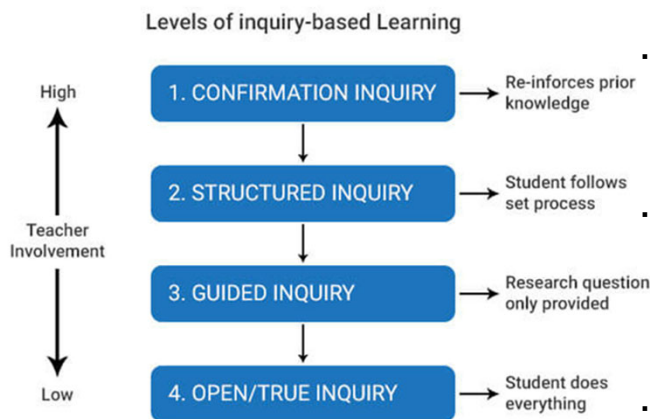
- Commonly used in STEM education
- Drawbacks:
 - Overload of information
 - Failure to determine what, and how much to study to solve a problem



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<https://www.slideshare.net/kategukeisen/problem-based-learning-basics>

Inquiry Learning



4 levels of inquiry learning developed by Schwab:

- **Level 1- Confirmation inquiry:** students are provided with the question and procedure (method) as well as the results
- **Level 2- Structured inquiry:** the learning goal is to introduce students to the experience of conducting investigations or practicing a specific inquiry skill, such as collecting and analyzing data.
- **Level 3- Guided inquiry:** The teacher provides students with only the research question, and students design the procedure (method) to test their question and the resulting explanations with guidance or mentoring support.
- **Level 4- Open/true inquiry:** students have the opportunity to act like scientists, deriving questions, designing and carrying out investigations as well as communicating their results.



Guided Inquiry Learning

- The teacher provides only the research question for the students. The students are responsible for designing and following their own procedures to test that question and then communicate their results and findings
- For undergrads guided inquiry is appropriate as per amount of work they can do for one course in a semester
- Good for introductory courses
- This method referred as process oriented guided inquiry learning (POGIL)
- POGIL has shown to improve student engagement and performance in assessments, especially among women, minority and low-income student groups



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Measuring engagement in online courses

How it is measure	How it should be measured
<ul style="list-style-type: none"> • Registration rates • Participation rates • Completion rates 	<ul style="list-style-type: none"> • Cognitive engagement • Behavioral engagement • Emotional engagement • Social engagement



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Engagement measures in classroom and online

Method	In-class	Online
Cognitive	student asking a question in class...	student starts a debate or asks a question
Behavioral	completes assignment on time, follows rules...	regularly logs in and watches full video segments
Emotional	appears excited about the content...	expresses that the content is useful
Social	shares information with their peers...	joins discussions and collaboration with other students



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Objective of Project

In this project, our main objective is to increase engagement in online education in the health information management and health informatics areas

Test new teaching and learning innovation in two HIM courses:

- HIM M200 – Database Design for HIM
- HIM M220 – Health informatics for Decision Support

Achieve through specific aims:

Sub aim 1: We will conduct a baseline survey to measure engagement in the two courses on cognitive, behavioral and emotional engagement

Sub aim 2: We will develop a student team-based learning monitor (STLM) within the LibreHealth EHR system to track activities, which are required to demonstrate competency transfer and student engagement

Sub aim 3: Evaluate the differences in student engagement between the Guided Inquiry learning methods and current active learning strategies used in the courses.



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Assessment Methods

- STLM and its use.
- Student engagement survey.
- Semi-structured interview.
- Student learning outcomes and course grades.



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Methodology

Baseline survey:

- We measured engagement in HIM 200 & HIM 220 class for the Summer 2018 batch
- By combining data from a multi-dimensional construct survey and Learning analytics from Canvas learning management system
- The survey questionnaire is based on the National Survey of Student Engagement
- It contained 25 questions (open and close-ended questions) related to four engagement components (cognitive, behavioral, emotional and social) and took about 15 minutes to complete
- This will be the baseline data on which we will compare the improvements of our research outcomes
- We will identify the different aspects of the course material that needs to be adapted for POGIL and then try and create the new material that will meet learning outcomes



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Methodology

Semi-Structured interview:

- An undergraduate researcher (who has already taken the course) will conduct the interview.
- The interview is planned such that it lasted between 30-45 minutes.
- It include questions about student's experiences on the POGIL and the STLM tool.



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Methodology

Analyze Engagement using STLM Tool:

- OpenMRS, an open-source EHR system is currently being used in the HIM and the graduate HI program at IUPUI .
- STLM tool is developed as a module of LibreHealth EHR- to capture mouse and keyboard events such as timings, order of actions, location of mouse/keyboards etc.
- It also features analytics and is able to generate comparative patterns of different users, when performing a task and identify relationships of the data that is captured by the monitor .
- The proposal is to introduce a new methodology in the HIM course, on the lines of POGIL, which is already an accepted educational practice in the field of Chemistry education.



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Methodology

- Students from the class will be divided into groups of 3-4 students.
- As part of the POGIL research design, each student will be part of two user/learner groups.
- The “inquiring student” called the iTrainee will be asked to create a set of tasks based on the concept that was explained on the lecture material. They will make an attempt at performing the task on their own. He will ask the other students of his group to perform the same task.
- This will be written by the student on a Canvas forum, and will notify rest of the students from his group. Other “responding students” called rTrainee, to attempt to complete the task that is put forth by the question of the iTrainee



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Methodology

- The STLM tracks the following: (1) time between clicks (2) time between hovering on buttons, fields and other web page elements (3) no. of selections on a drop-down or radio button, before the appropriate option is finally selected (4) copy pasting of text into the text fields.
- The STLM will also provide comparative statistics of these to student groups. The mouse simulation recording the action of the instructor, will thus allow both the iTrainee and rTrainee to discover the most appropriate way to achieve the task.



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Methodology

Modify Course and Modify STLM

- The modified project will be run twice, the second time by incorporating feedback from the first cycle of modified course content
- The data for student engagement will be captured through focused group discussions that will be conducted by the undergraduate researcher who has already taken the previous version of the course.
- To improve freedom and amicability with the respondents
- The student evaluations of the course will also be taken into consideration, along with qualitative feedback from the focused group discussion, as well as the engagement survey
- All three will be used to improve the STLM module, as well as modify the content of the courses for the second round of course delivery.



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Outcomes

At the beginning, only the Green button is available to capture the steps for the activity

The red stop button gets available once the recording is started and only to stop recording the activity

The Yellow button is the revert button to revert or redo any task and start over again. The Blue compare button is to compare the answers within the group

Steps involved in capturing the task performed in STLM



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Outcomes

POGIL ACTIVITY I

Fill in the table with fields from the picture that fit into each category

Category	fields
Data	
Information	
Knowledge	
Wisdom	

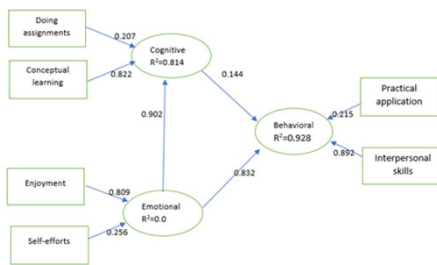
Note: This Activity needs to be performed in STLM using 'Annotations' feature. Please refer page 1 of STLM user manual for instructions on using this feature.

POGIL task and STLM tool with annotation and compare feature



Outcomes

PLS Model for Student Engagement



- We found that emotional engagement has a strong positive influence on the cognitive and behavioral engagements.
- Thus, effort needs to be made by teachers to first activate emotional engagement of the students, so that the students will demonstrate positive behaviors with learning the course content, and also engage cognitively with the content.

- For e.g., an instructor may conduct a class debate on negative and positive impact of annual screening mammograms on the detection and treatment of breast cancer the before teaching about how to extract data from an epidemiology database.
- Our model suggests that a positive/negative emotional response to a given task, might result in increase/decreased cognitive and behavioral engagement towards the learning process.
- We are trying to validate this model with IUPUI NSSE 2016 and Spring 2018 data as well



Project Members

Principal Investigator:

Saptarshi Purkayastha, Ph.D. : He is responsible for overseeing and coordinating the project, which includes monitoring progress, research design, and supervising staff/students. He is budgeted for 2% of his time.

Collaborators:

Lisa DesNoyers M.P.H., RHIA: She is responsible for development and implementation of the inquiry based learning methods into the courses.

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Project members

- **Asha Surapaneni** : She is graduate student responsible for modifying the course content and for implementing the surveys in the course. She has developed the STLM tool
- **Parvati Naliyatthaliyazchayil:** She has developed the UI for the STLM tool, along with another graduate student **Ashwini Kowkutla**.
- **Pallavi Maity:** She is a graduate student working on developing use cases for STLM tool
- **Ramachandrarao Barma:** He is a graduate student working on the statistical analysis of the survey results
- **Kelsey Rayburn:** Undergraduate student recruited the student subjects and performed the qualitative interviews with HIM students..
- **LibreHealth community liaison** : Robert O'Connor is responsible for provision of the EHR software for deployment and provide continued support with the software for the duration of two years. A consultant during the project duration representing the LibreHealth community



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Questions?



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Thank you!



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