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Work in Progress - Peer Directed Learning in a Project Based Model

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Abstract **- Iron Range Engineering is a new, unique, undergraduate program using problem-based learning. One guiding principle is student responsibility for learning. In order to facilitate learning, faculty and students alike have come up with several learning methods. Learning modes may include self-directed learning, peer-directed learning, one-on-one faculty-directed learning, or industry mentored learning. Peer-directed learning often manifests in the form of learning groups (a group of students learning similar competencies), led by either a faculty member or a student who has previously excelled in that competency and has taken an interest in pursuing advanced credit. Recently, Iron Range Engineering has begun to incorporate student written and student led model eliciting activities. These show promise for creating engagement, exposing misconceptions, and providing high-level learning opportunities for peer-students and peer-teachers. The initial results of these methods have been very positive. A high level of engagement and a high level of desire to complete self-directed learning have been observed from peer-teachers and students. Students getting the opportunity to lead these learning groups comment on a newfound interest and clarity in the subject matter. Both sides are able to gain metacognitive knowledge which will help them as a student, engineer, and in future academic careers.**

Index Terms - Model-eliciting activities, Peer-teaching, Problem-based learning, Student engagement.

IRON RANGE ENGINEERING

On Minnesota's Mesabi Iron Range a new model for engineering education has been externally funded and implemented as of January, 2010. The Iron Range Engineering (IRE) model is a unique, undergraduate problem-based learning (PBL) engineering program. Students at IRE, who are mostly graduates of Minnesota's community colleges, are upper-division engineering students enrolled at Minnesota State University - Mankato. IRE students do not take classes. Rather than studying engineering in the context of 15-week engineering courses, IRE students work in mining, milling, and manufacturing industries solving complex and ill-structured industry problems. A guiding principle for the IRE model, as with all PBL programs, is student responsibility for their own learning [1]. At the beginning of each project cycle, students identify which learning outcomes will be addressed throughout the project. Prior to graduation, students of IRE are required to complete sixteen one-credit core competencies. Eight of these are in electrical areas and eight are in mechanical areas. In addition, students will also complete sixteen credits in self-defined advanced competencies. In order to facilitate learning, IRE faculty and students alike have come up with several methods to better convey and structure these competencies [1], including self-directed learning, peer-directed learning, one-on-one faculty-directed learning, or industry mentored learning.

PEER-DIRECTED LEARNING OPPORTUNITIES

Many opportunities to implement and observe peer-teaching in the IRE classroom have presented themselves. Peer-directed learning most often manifests in the form of learning groups. Student led learning conversations, one-on-one learning sessions, student written and run model-eliciting activities (MEAs), and student participation in oral exams are also becoming useful practices used at IRE.

- **Learning groups** are made up of students taking similar competencies and can be led by a student who has previously excelled in that area and has an interest in pursuing advanced credit in the subject. This poses a unique opportunity for a student to share knowledge of a subject with his peers. By giving students the opportunity to revisit the material, as well as help others through the difficult portions of coursework, they are able to reflect upon their own difficulties and solidify the knowledge they posses in this area [2]. The students in the group are also able to get perspectives and help from someone who very recently struggled through the same concepts they are dealing with now. This interaction can increase moral and interest in a topic area [3-4].
- **Learning conversations** are similar to lectures but much more interactive and bidirectional. Learning conversations are generally requested on a particular topic, one the students are working on but are having difficulty with, and are open to any students who wish to attend. The leader of this learning conversation prepares to speak about the topic, but through the course of student interaction can lead the discussion in many different directions. These are generally led by instructors, but recently, learning conversations led by students have become common and effective. This learning is focused on conceptual understanding, which

engages both peer teachers and learners, while giving them immediate feedback on their knowledge in the subject [5]. Discussions like these are where some of the most concrete learning at IRE occurs, often inspiring students [4], who often do additional research to discover knowledge about topics they often ignore.

- **One-on-one peer learning sessions** occur every single day at IRE and are an integral part of the learning structure. Students in PBL environments eventually become highly competent in several areas [1]. As experts, other students come to these peers for help. By having student experts, PBL programs increase the availability of this knowledge by several factors over conventional instruction [4]. The opportunity to help or be helped on a topic by a peer gives the opportunity for learning to both individuals.
- **Model-eliciting activities** (MEAs) are unique learning activities where students are given a problem, put in real world context, for which the answer is an original, generalizable, and verifiable model and procedure [6]. Recently, upon receiving training form Dr. Tamara Moore. The IRE program has begun to incorporate student written and student led MEAs within learning groups. These show particular promise for increasing student engagement, exposing misconceptions, and providing high level learning opportunities for both the peer-students and peer-teachers [6].
- **Oral exams** are the replacement at IRE for written final exams. Students create a presentation to showcase what they have learned in each competency, which is to be shown to instructors. This presentation is followed by an extensive questioning period in which the faculty members push students to the bounds of their knowledge. Oral exams are open for student viewing and can be done in teams, but until recently, faculty provided all of the questions and comments. For some core competencies the peer teacher of the learning conversation has been invited to assist in the evaluation during the oral exam. This provides the opportunity to let the peer-teacher discover areas in which the students excel or struggle, and if there are additional areas not covered that the instructors highly value.

These learning activities are used in order to achieve a high level of engagement for peer-teachers and students in learning groups. Another expected result is a high level of desire to complete self-directed learning. These activities are also believed to correlate with a highly increased desire of students to pursue graduate education. These activities will also provide increased clarity on many issues that have previously given peer-teachers difficulty at a conceptual level, even if they easily display knowledge at a factual and process level. In addition to all this, the major benefit expected for students on both sides is gaining metacognitive knowledge which will help them as a student, an engineer, and in any future academic career.

FUTURE WORK

IRE evaluators are studying the wide-ranging impacts of learning in this model on the students who complete it. In particular they are studying the affective, metacognitive, and cognitive impacts using tools such as concept inventories, the Perry Scale for Intellectual Development, the Motivated Strategies for Learning Questionnaire (MSLQ), ABET portfolio assessments, and the Self-Directed Learning Readiness Scale (SDLRS). The results of this work will be analyzed to determine impacts of peer-led learning on the student development.

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