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ABSTRACT

Competitions are indispensable components of skill-based activities. Applied skills are critical parts of many information system courses. In this project we implemented a competition-based learning in teaching of an applied data mining course. Students created predictive models and scored them on a publicly available competition platform (Kaggle). Students' motivation for learning and satisfaction with learning process were measured and students were asked to reflect on their learning process. Students' responses and reflections are consistent with the hypotheses that competition-based learning, when accompanied by guidelines and formative feedback, can enhance students' intrinsic motivation and their satisfaction with the learning process.

INTRODUCTION AND RESEARCH MODEL

Competitions are indispensable components of many skill-based activities. They are believed to enhance participants' confidence and encourage stepping out of one's comfort zone. They are also a means to advancing team work and accountability. In teaching, however, competitions are a controversial topic. Some research studies have shown that competitions lead to short term gains at the cost of the longer term deep learning (Shindler 2009). Other research studies posit that competitions encourage a transition away from just-enough-effort in learning through fostering intrinsic motivation (Carroll 2013). Intrinsic motivation is a natural desire for and perseverance toward learning and creativity (Deci & Ryan 2000). Researchers believe that human-beings are born with abundance of intrinsic motivation which over time fades due to imposed structures, roles, and responsibilities defined in the society. In higher education, intrinsic motivation will improve processing, retention, and application of knowledge and skills taught in courses. This research study employed competitions as an instrument for advancing academic extrinsic motivation (Richardson *et al.* 2012) in order to elicit and foster intrinsic motivation for learning data analysis, processing, and interpretation (Deci & Ryan 2000). The literature on using games and competition in teaching has differentiated between *competitive* learning (CBL) and *competition-based* learning (CnBL) (IRMA, 2015). In CBL, learners' scores depend on their rank in the competition whereas in CnBL learners' scores are independent of their rank in the competition. In this study we used the latter approach. Students were asked to participate in competitions for half of their data analysis assignments but their assignment scores did not depend on the ranks they earned in the competitions. The study's research model is shown in Figure 1. Competitions are used as an extrinsic motivation mechanism and are expected to enhance intrinsic motivation for learning and satisfaction with learning process. More specifically, students were asked to score on Kaggle competitions the predictive models that they created for the course assignments; the competitions-based assignments were completed individually.
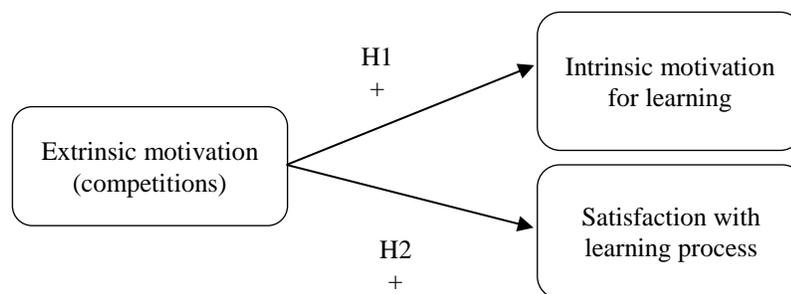

Figure 1: Research model

MEASUREMENTS AND ANALYSES

The class used Kaggle[1] for competitions and scorings of models; Kaggle is platform for predictive modeling through which many organizations host competitions by providing datasets, goals, and evaluation criteria. Individuals and groups from around the world can compete in any of the competitions. In addition to competitions Kaggle provides environment for creating, debugging, and running code. Each course competition in class was preceded by one or more lectures on predictive modeling technique and one or more supervised lab exercise(s) in which students practiced applying a model to a dataset.
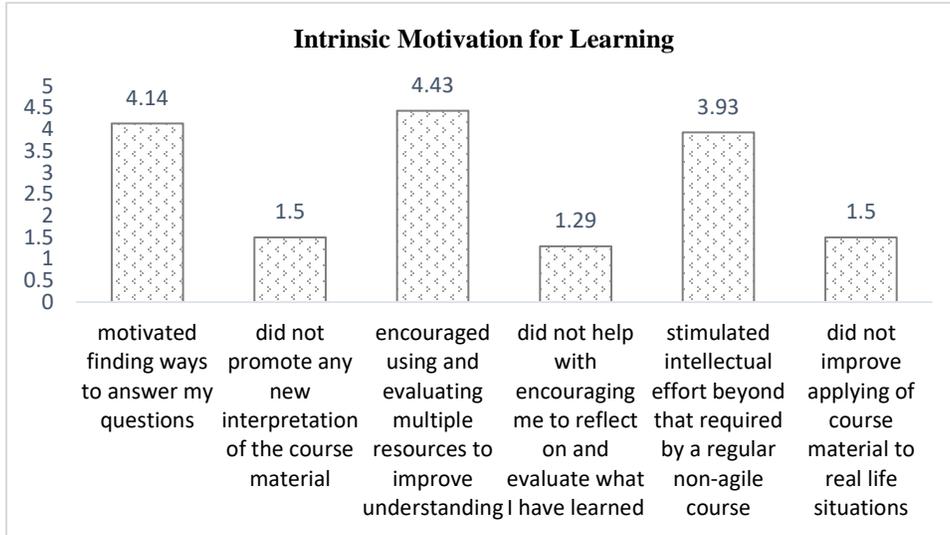

Figure 2: Students' perceived intrinsic motivation for learning
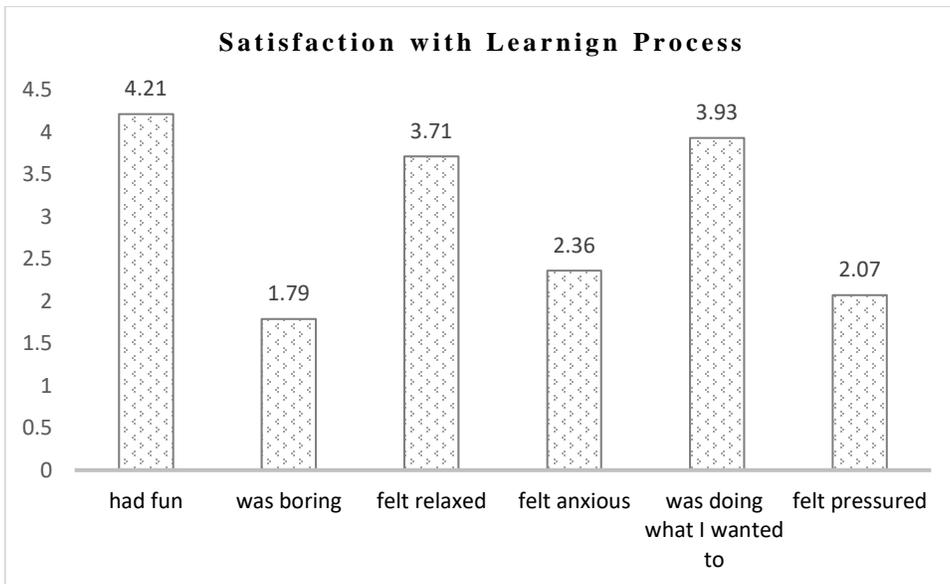

Figure 3: Students' perceived satisfaction with learning process

To measure intrinsic motivation, this study has employed a shortened variation of the twenty-two question instrument from the inventory of measurement instruments for intrinsic motivation provided by the Self-Determination Theory organization[2] (SDT). The original SDT questionnaire covers variety of dimensions, a subset most relevant to learning in a course context were

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1 https://www.kaggle.com/

2 http://selfdeterminationtheory.org

selected for this study. Students' satisfaction with the learning process will be assessed using items borrowed from the IDEA measurement item pool for motivational impacts of teaching methods[3] . IDEA provides a validated pool of questions for evaluating different areas of performance in a teaching and learning environment. The set of questions used for this study has been included in Appendix A. 12 out of 14 students completed the questionnaire that was administered at the end of the semester and the average scores for each question are shown in Figures 2 & 3.

Students were asked to reflect on the competitions and share their feedback on how to improve the process (questions 13 &14 in Appendix A) in order to enhance intrinsic motivation for learning and satisfaction with learning process. Summary of themes derived from students' comment are shown in Figure 4. Major areas of improvement as noted by students were providing a more structured guide on how to tweak models & a tool for tracking progress, allowing students to work in pairs/groups, and creating a forum for viewing others' solutions, commenting on them, and reflecting on own failed/succeeded trials.
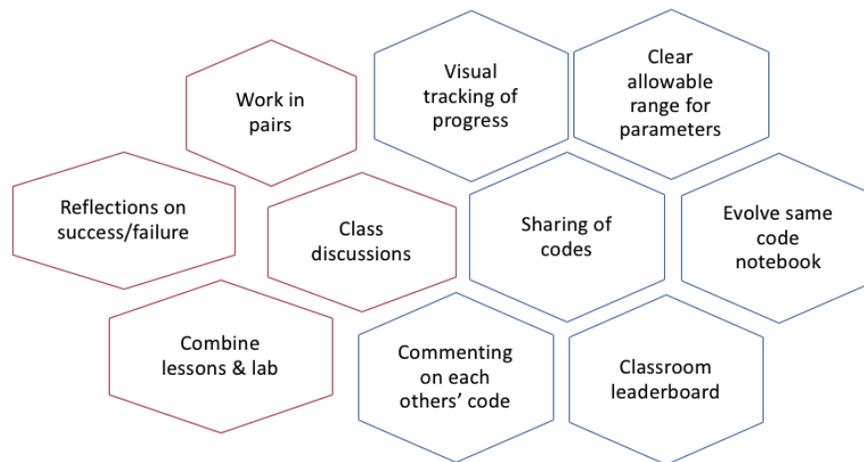

Figure 4: Students' ideas for improvement

SUMMARY AND CONCLUSION

In this study scoring predictive models on a publicly competition platform was used as an extrinsic motivation mechanism; students' reported higher levels of intrinsic motivation and satisfaction with learning process. Students' suggestions for improvement included adding mechanisms for enhancing interaction among students, employing better tools for tracking each student's progress, and creation of private classroom leaderboards (i.e., Kaggle InClass). The study was completed in a small elective higher level information systems course, therefore has limitations in generalizing to larger classrooms and required courses.

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[3] http://www.ideaedu.org

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Appendix A

1	Scoring my models in Kaggle competition was fun.
2	Scoring my models in Kaggle competition motivated me to find ways to answer my own questions.
3	I thought that scoring my models in Kaggle competition was very boring.
4	Scoring my models in Kaggle competition did not promote any new interpretation of the course material.
5	I felt relaxed while scoring my models in Kaggle competition.
6	Scoring my models in Kaggle competition encouraged me to use and evaluate multiple resources to improve understanding.
7	I felt anxious while scoring my models in Kaggle competition.
8	Scoring my models in Kaggle competition did not help with encouraging me to reflect on and evaluate what I have learned.
9	I felt like I was doing what I wanted to do while I was scoring my models in Kaggle competition.
10	Scoring my models in Kaggle competition stimulated me to intellectual effort beyond that required by a regular non-agile course.
11	I felt pressured while scoring my models in Kaggle competition.
12	Scoring my models in Kaggle competition did not improve applying of course material to real life situations.
13	What could motivate you more to experiment with models and parameters in order to get betters scores in Kaggle competitions? Describe in 40-60 words what can motivate you to explore and experiment with models more and learn beyond the classroom teaching.
14	What could make you more satisfied with the process you followed to experiment with models and parameters in order to get betters scores in Kaggle competitions?
Table 1: Online Questionnaire – Motivation & Satisfaction **5-level Likert Scale (strongly disagree to strongly agree)**	