Work in Progress: Understanding how Action Modes® can Help or Hinder Students in Self-paced Courses

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Abstract

Nationwide, a surge in students who are under-prepared for collegiate mathematics has left institutions struggling to meet the needs of these learners. Many schools have moved to online or hybrid instructional models for developmental mathematics. These models work very well for many students, but not at all for others. At Clemson University, all STEM majors who are not yet calculus ready take precalculus under a self-paced hybrid course model that includes an asynchronous online component using ALEKS® (Assessment and LEarning in Knowledge Spaces) and a face-to-face component with targeted direct instruction in small groups.

The ALEKS® software allows students to master objectives at their own pace following an individualized learning path. One lens for understanding why some students struggle in hybrid courses is to observe how a student approaches a task. The Kolbe A™ Index measures an individual's *conation*, his/her method of operation when given the flexibility to choose how to approach a task. In the hybrid precalculus course at Clemson University, each student works independently on the self-paced component and can be assumed to follow his/her natural instincts for task completion.

The objective of this study is to use a third-party assessment of conation to predict at the start of the semester which students will struggle in the hybrid model course and, ultimately, to offer recommendations on how to help these students complete such courses. This study focuses on the correlation between Kolbe A™ results and student performance in hybrid precalculus to determine if certain conative categories are particularly well-suited or poorly-suited to this course model. We report preliminary data from a Fall 2016 pilot study and discuss next steps to predict which students are "at risk" on the basis of Kolbe A™ results.

Course Structure of Precalculus

Calculus is a common prerequisite for introductory courses in science, technology, engineering, and mathematics (STEM) disciplines. Students who are not yet ready to take calculus must take precalculus in order to start the path towards a degree in a STEM discipline. The precalculus course at Clemson University is a pass/fail hybrid course in which students have a face-to-face component as well as an online self-paced component using ALEKS® (Assessment and LEarning in Knowledge Spaces).

Self-paced component: ALEKS®

ALEKS® is an online assessment and learning system that individualizes learning paths using a proprietary web of conditional probabilities for topic acquisition[1]. ALEKS® includes content information, practice problems, and integrated learning resources[1]. Each student takes an Initial Knowledge Check (IKC) in order for ALEKS® to determine what the student already knows and where to start the student's individual path.

ALEKS® can be configured in many ways to meet an institution's specific instructional design needs. At Clemson University the course content, ranging from adding fractions to conic sections, is segmented into 12 sequential objectives. There are no fixed due dates for objective completion; students move to the next objective when they have reached a minimum mastery level (80%-95% depending on the objective). The course is graded pass/fail and students must complete all 12 objectives and pass an exit exam in order to pass the course. Students are given a timeline of target dates for objective completion. The intention is to provide students with a gauge of their progress in the course: ahead, on schedule, or behind schedule (Figure 1).
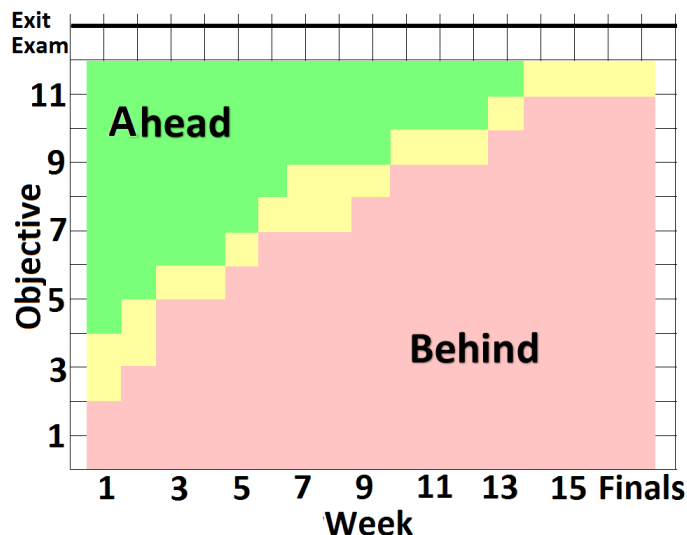

Figure 1: Weekly timeline with targets for completion of objectives

Conation and Kolbe A™

Although student success in first-year courses has been studied extensively through many lenses[2,3,4], there have been few studies focusing specifically on hybrid models. In a two-institution study, Clayton et al. found that high motivation correlated with student preference for hybrid-model courses[5]. Manuelito determined that self-regulated behaviors correlated with student success in hybrid science courses[6]. There is therefore some evidence that both behavior and motivation are factors in student success in hybrid courses.

We focus more narrowly on conation, which is closely linked to both motivation and behavior. Following on the work of Huitt and Tallon[7,8], we consider three aspects of the mind: cognition, affection, and conation. Conation is exhibited when an individual applies cognition (learned information) and affection (motivation/value) to strive at a task utilizing instinctive actions[9,10]. Put another way, conation is an individual's self-determined behavior[9,10]. In this study, we utilized a commercially available tool, Kolbe A[TM], to measure individuals' conation.

Developed by Kathy Kolbe, the Kolbe A[TM] assessment has been used most often in business settings for professional development involving teamwork[9,11,12]. Validation studies have shown no indication of gender, racial, or ethnic bias, and have established test-retest reliability[11,12]. The Kolbe A[TM] is a 36 question survey that provides four numerical scores, each representing an Action Mode® (Fact Finder, Follow Through, Quick Start, and Implentator)[9,11]. Based on the combination of scores, Kolbe A[TM] determines the dominant mode(s) of operation for an individual. Kolbe Corporation has identified 17 distinct action combinations, or Natural Advantages[TM], describing how individuals navigate through a problem or process in the absence of external restrictions[11]. Each Natural Advantage[TM] is given an archetypal descriptor such as Researcher, System Analyst, Pioneer, or Entrepreneur. These are not job titles, but rather terms intended to evoke a mental image of the traits embodied within the category.

We hypothesize that natural work patterns strongly affect an individual's performance in self-paced courses because external limitations such as time restrictions or number of attempts are not in effect. Since the hybrid course is self-paced, we expect that students' natural tendencies to action will surface in their work patterns over the course of the semester. Our pilot study poses the specific research question:

> *Does Kolbe A[TM] Natural Advantage[TM] category predict work pattern and course performance in the self-paced component of a hybrid precalculus course?*

Methods

In the beginning of fall semester, we invited all 149 students enrolled in precalculus to participate in the study; 23 accepted. Participants took the Kolbe A[TM] assessment out of class; there was no subsequent discussion of the results with the participants. Each participant's Kolbe A[TM] result was labeled as one of the 17 Natural Advantages[TM] developed by Kolbe A[TM] using the numerical combination of the Action Modes®.

Work pattern data (e.g. number of hours logged, number of topics covered attempted, length of login session) were collected through reporting features in ALEKS®. Demographic data such as academic year and intended major were also collected. The instructor did not know who completed the Kolbe A[TM] nor the distribution of Natural Advantages[TM] among the participants. Although the instructor monitored course progress for all students, there were no class-wide interventions targeted specifically at work patterns of study participants. This paper focuses solely on weekly progress in the course within specific Natural Advantage[TM] categories.

Results and Discussion

In ALEKS®, each student takes an initial knowledge check (IKC) to determine how many of the course topics he/she knows well enough that they serve as a mastery base for future topic acquisition. In the study semester, the mean result from the IKC was 69 of the 405 course topics. In Figure 2, we provide the distribution of IKC counts for the entire class in order to provide context for this discussion. We also note that the overall pass rate for the course was 65.8%, and 65.8% of students had an IKC of 49 or higher, but there is no clear course-wide dividing line to group the students into pass/fail categories based solely on IKC. However, clear dividing lines do emerge within certain Kolbe A Natural Advantages™.

Of the 23 participants, three had inconclusive Kolbe A™ results and were excluded from the analysis. Of the remaining 20, 14 fell into three categories: Mediator Natural Advantage™, Researcher Natural Advantage™, and Strategic Planner Natural Advantage™. In this paper, we focus on the patterns observed among these 14 students.
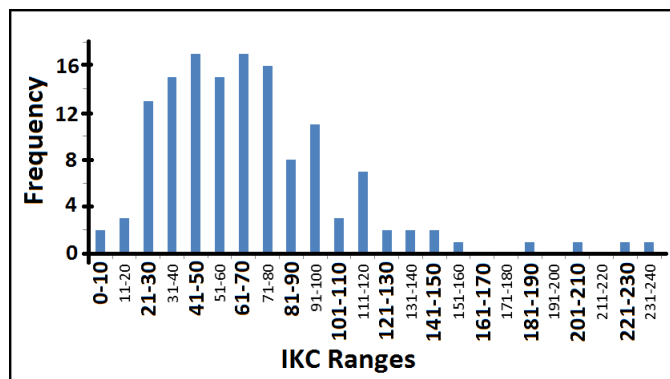

Figure 2: Histogram of Initial Knowledge Check counts for all students enrolled in precalculus during the study semester.

Researcher as a Natural Advantage™

Five of our participants were identified as Researchers; their dominant Action Mode® was Fact Finder (gathering information before acting). Characteristics of the Researcher archetype as described by Kolbe Corporation include "prioritizing everything from topics to use of time", "allocating resources", "verifying the practicality of decisions", and "redefining complex problems as attainable goals"[13].

Three of the five researchers had IKCs below 49, but only one (with an IKC of 19) failed (Figure 3a). Four of the five Researchers passed the course; each successful Researcher went at an overall steady progress despite reaching a multi-week plateau during the semester. We hypothesize that Researchers used their inclination to *allocate resources* and their desire to *verify the practicality of decisions* to establish clear and reasonable goals for their own course progress. They appear to have broken the course into attainable weekly progress goals. Since gathering information is the initial action for Researchers, the specific information provided by the IKC may have helped them prioritize and allocate the resources available to them.
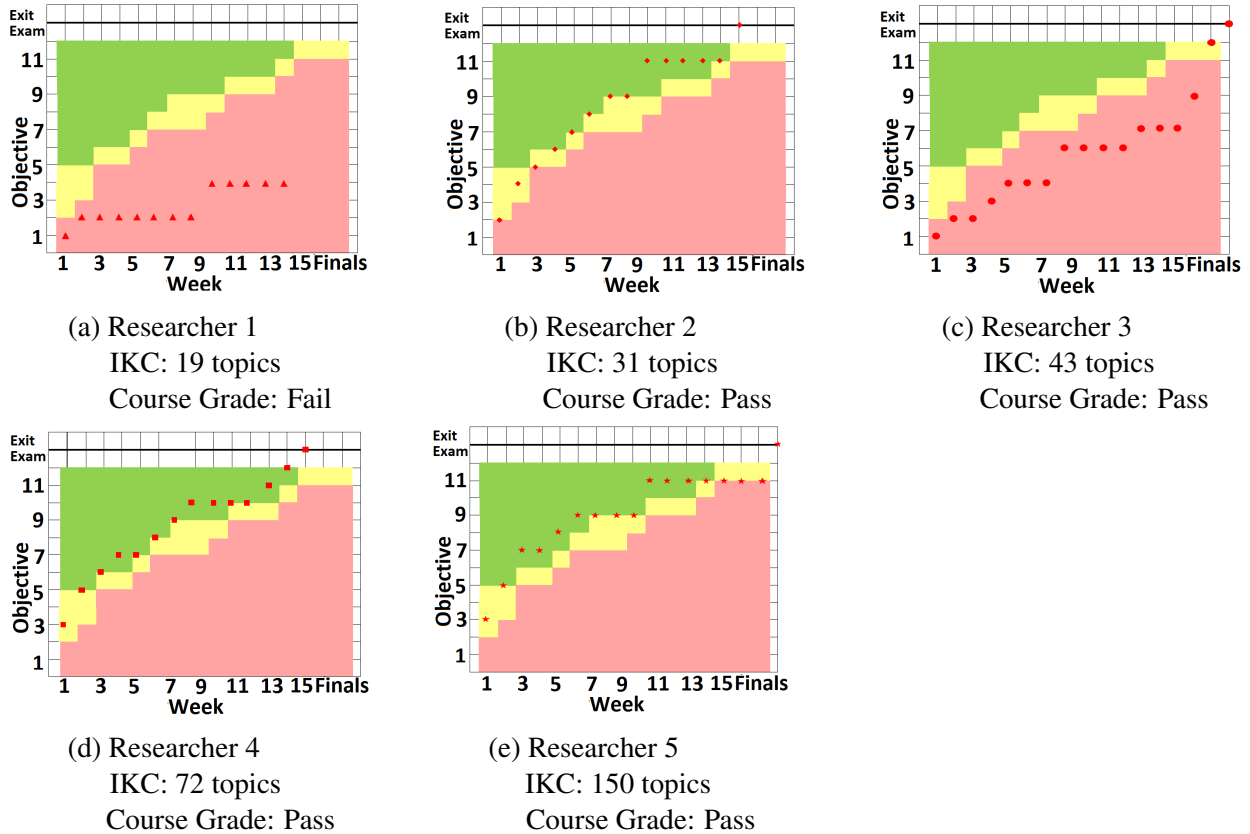
(a) Researcher 1
IKC: 19 topics
Course Grade: Fail

(b) Researcher 2
IKC: 31 topics
Course Grade: Pass

(c) Researcher 3
IKC: 43 topics
Course Grade: Pass

(d) Researcher 4
IKC: 72 topics
Course Grade: Pass

(e) Researcher 5
IKC: 150 topics
Course Grade: Pass

Figure 3: Course Progress, IKC, and course outcome for each of the 5 Researchers

Strategic Planner as a Natural Advantage™

Six of our participants were identified as Strategic Planners; their dominant Action Modes® were Fact Finder and Follow Through (gathering and then organizing information). Characteristics of the Strategic Planner archetype as described by Kolbe Corporation include "designating programs that will be completed","evaluating workflow", and "doing the most important thing first"[13]. They thrive when they have a thorough understanding of process[13].

Three of the six Strategic Planners in our study had IKCs below 49. All three failed (Figure 4, along with one who had a IKC greater than 49 (see Figure 4). We hypothesize that in the absence of hard deadlines for this course, other academic requirements received higher priority in Strategic Planners' natural tendency to evaluate workflow. The process for passing was communicated in the syllabus as recommended dates for completion, with the understanding that catching up was possible even after falling behind. We suspect that the Strategic Planners may have based their allocation of resources for later content objectives on the time required for completing earlier objectives, without taking into account that their pace would be slower with more difficult content. The work patterns support this hypothesis: all six of the Strategic planners hit a significant plateau after early quick progress. Preliminary analysis of qualitative data from the study also supports this hypothesis, but the analysis is not yet complete.
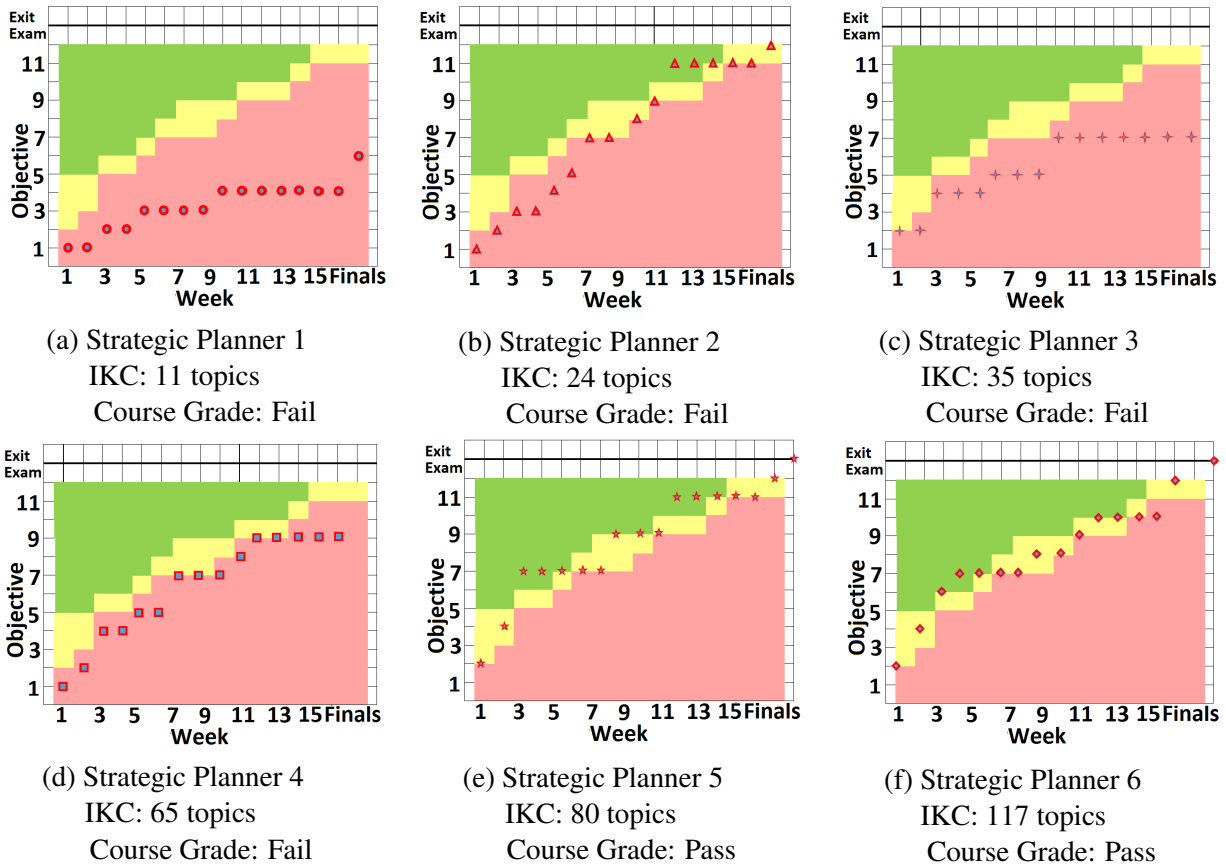
(a) Strategic Planner 1
IKC: 11 topics
Course Grade: Fail

(b) Strategic Planner 2
IKC: 24 topics
Course Grade: Fail

(c) Strategic Planner 3
IKC: 35 topics
Course Grade: Fail

(d) Strategic Planner 4
IKC: 65 topics
Course Grade: Fail

(e) Strategic Planner 5
IKC: 80 topics
Course Grade: Pass

(f) Strategic Planner 6
IKC: 117 topics
Course Grade: Pass

Figure 4: Course Progress, IKC, and course outcome for each of the 6 Strategic Planners

Mediator as a Natural Advantage™

Three of our participants were identified as Mediators; they had no dominant Action Mode®, but rather adjusted their Action Modes® based on success. Characteristics of the Mediator archetype as described by Kolbe Corporation include "adapting to needs," "responding as needed," "being adaptable," and "being a team player"[13].

All three Mediators had a significant plateau and fell behind during the semester. All three also put in a significant closing effort and completed all 12 objectives at the very end of the semester. Two out of three Mediators passed the exit exam; the one who started with an IKC below 49 did not have time to assimilate the information and failed the exit exam (Figure 5). We hypothesize that the plateaus for the mediators occurred when they hit challenging content, and that the point at which that occurred is linked to IKC. With the flexible structure of the course and the lack of hard deadlines, Mediators may be more inclined to put off mastering challenging material, anticipating that they will have time to catch up by the end of the semester.
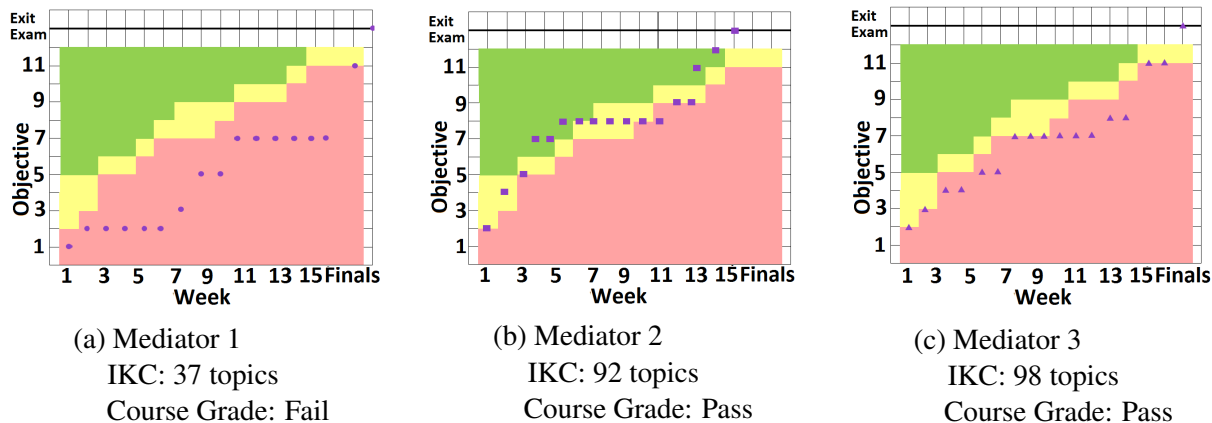
(a) Mediator 1
IKC: 37 topics
Course Grade: Fail

(b) Mediator 2
IKC: 92 topics
Course Grade: Pass

(c) Mediator 3
IKC: 98 topics
Course Grade: Pass

Figure 5: Course Progress, IKC, and course outcome for each of the 3 Mediators

Summary

Our goal was to determine if Kolbe A Natural Advantages[TM] could be used to predict work patterns and course performance in the self paced component of a hybrid course. Although our data is limited, we are guardedly encouraged by the results. Within each of the three Natural Advantages[TM] for which we had multiple participants, the work patterns were consistent with characterizations provided by Kolbe Corp[®]. Ordering participants based on IKC within each Natural Advantage[TM] provided a clear demarcation between failing and passing, and the dividing line was different for each category (Table 1). Researchers appear to be at an advantage, while Strategic Planners appear to be at a distinct disadvantage. The three Mediators followed the "natural" dividing line of a 49 IKC demarcating pass/fail, but there was a significant gap between their IKCs and we are reluctant to make even a tentative claim about this small sample.

Table 1: Course results ordered by IKC and classified by Natural Advantage[TM]. "P" and "F" represents "Pass" and "Fail".

IKC	11	19	24	31	35	37	43	65	72	80	92	98	117	150
Mediator						F					P	P		
Researcher		F		P			P		P					P
Strategic Planner	F		F		F			F		P			P	

Limitations

There are significant limitations to this pilot study. Since completing the Kolbe A[TM] required additional out-of class initiative, our sample is almost certainly biased. With only 23 participants out of 149 enrolled, we have few data points and cannot confidently generalize these work patterns to the larger population. Although there were not course-wide interventions, the instructor had

individual conversations with many students in the class regarding their work patterns. We cannot separate effects due to instructor intervention.

Future Directions

Despite the limitations, we are cautiously optimistic about the potential for the Kolbe A™ to identify students whose natural tendencies to action put them at a disadvantage in a self-paced course component. In addition to the quantitative data collected, we have interview data from seven of the participants. Analysis of the qualitative data is underway. The quantitative results are sufficiently promising for us to expand the study. We plan to administer the Kolbe A™ during class time to all precalculus students at the start of next fall semester.

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