The Benefits of Formative Assessment & Instruction Intervention

Kaplan Test Prep & The Texas JAMP Program

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Background

The Joint Admission Medical Program (JAMP)was created by the Texas legislature to support and encourage highly qualified, but economically disadvantaged, Texas students to pursue a medical education. Since the program's inception in 2003, Kaplan Test Prep has provided JAMP participants with test preparation services with the goal of improving MCAT scores.

Summary

In 2011, Kaplan expanded and modified the test preparation program to address foundational knowledge gaps to further improve the likelihood of matriculation into medical school for student-participants. Using the latest work and advances in learning science, Kaplan added formative assessment, intervention classes, tutoring, and staff training features to the JAMP program. The new course now includes the following:

- **Knowledge Assessment Test (KAT).** This test is used to diagnose any gaps in a student's knowledge of the foundational science crucial for succeson the MCAT and in medical school.

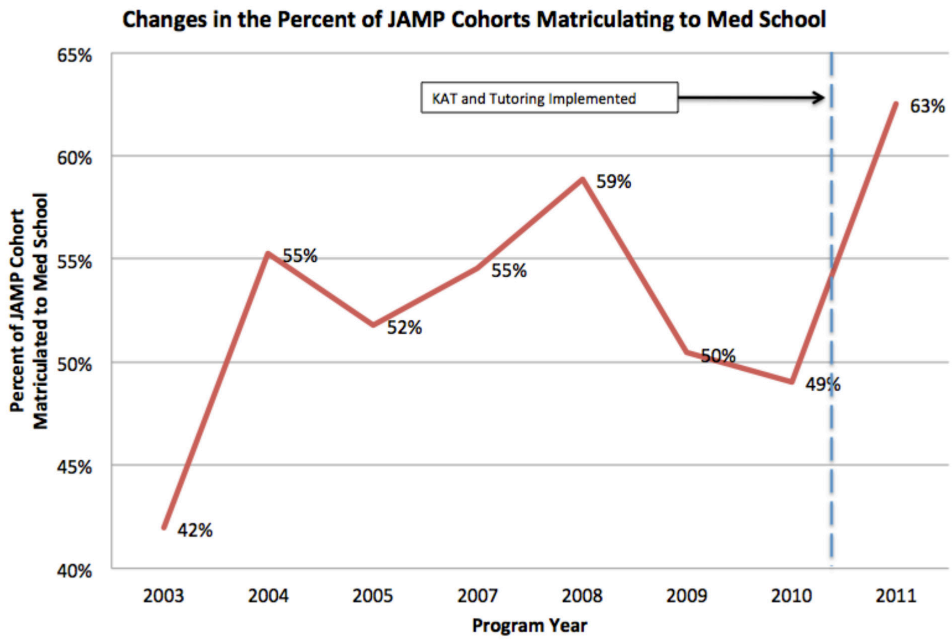
- **Enrichment Classes.** Mastery of fundamental knowledge plays a critical role in future learning. These intervention classes are designed to remediate any knowledge gaps identified by the results of the KAT.

- **MCAT Preparation.** The core component of previous programs, the MCAT prep tailors the content and instruction specifically to how it's tested on the MCAT. AA scores increased from an average baseline of 13.53 to 14.09 at midpoint to a 15.12 by the end of the program—a 12% improvement.

- **Small-Group Tutoring.** Based on the results of full-length MCAT exams, opportunities are identified to help students with any remaining challenges in the content.Participants were also asked to identify the disadvantages they faced, both social and economic. The study found that the higher number of disadvantages, the more students improved their Academic Average performance from baseline to final score.

- **Staff Training.** Training was provided to JAMP faculty directors to help them better support, mentor, and motivate students as they work through the program.

Applying these evidence-based enhancements to the program has led to a direct, positive impact on student matriculation into medical school—a 14% increase over a one-year period. See chart below:



The Learning Science Behind The Decisions

What's the importance of identifying and addressing weaknesses in foundational knowledge?

A critical component of the JAMP test preparation program was the implementation of a Knowledge Assessment Test (KAT) to identify weaknesses in students' foundational science knowledge and to provide enrichment classes for students demonstrating a lack of proficiency in these essential science topics. We took this approach for several reasons:

1. The critical nature of prior knowledge to future learning
2. The challenge students face in acquiring science proficiency when misconceptions go unchallenged
3. The efficacy of formative assessment systems in improving student achievement

The Role of Prior Knowledge

Incoming—or prior knowledge—has been posited as the most import determinant of subsequent learning (Shute &Zapata-Rivera, 2012). Studies in the differences between experts and novices in a given domain have shown that expert performance is not the by-product of more sophisticated strategies in abstract reasoning, but a greater and deeper familiarity with the domain in question.

In a classic study of novice and expert chess players, Chase and Simon (1973) allowed chess players of different competency levels to view a chessboard with pieces for 5 seconds. The board was then hidden from sight and the players were asked to reconstruct the chessboard. If they did not place the pieces correctly these pieces were cleared and they were allowed to view the original board again for 5 seconds before attempting to recall the correct placement of the pieces. The players were presented with boards that would normally occur during game play and randomly configured boards. Expert chess players were able to recall significantly greater number of pieces than less experienced players from board configurations that naturally occurred during game play. However, this was not the case when the boards were randomly configured. Prior knowledge of the game had a dramatic impact on recall.

A similar study by Chi (1978) demonstrated the consistency of these findings. Ten-year-old chess players, while demonstrating less proficiency in the ability to recall a span of numbers than adults, demonstrated significantly greater proficiency at recalling chess positions on a board as in the Chase and Simon (1973) experiments. In light of these and similar studies, Glaser (1984) has argued that problem-solving difficulty of novices can be attributed largely to the inadequacies of their knowledge bases and not to limitations in their processing capabilities such as the inability to use problem-solving strategies.

The Role of Misconceptions

Identifying these inadequacies in novices' understanding of foundational content is critical. Students, according to Branford et al. (1999), come to the classroom with misconceptions about science, for example, that if not engaged will hinder their ability to grasp new concepts and information. Countless studies have demonstrated that students without proper guidance and interventions may develop entrenched misconceptions in a variety of scientific disciplines. In fact a publication entitled Science Teaching Reconsidered from the National Academies Press cited a bibliographical resource containing approximately 3,500 items on the topic of science misconceptions.
A classic and vivid demonstration of these misconceptions was captured in a Sadler and Schneps video in 1989, entitled "A Private Universe –Misconceptions that Block

Learning." The video documents the misconceptions held by a randomly selected group of graduating Harvard seniors and faculty. Twenty-one of the twenty-three people interviewed were unable to describe the cause of the change in seasons independent of the extent of their science education. One high school student that was interviewed in greater depth showed the tenacity of her misconception about the changes in seasons and phases of the moon in spite of focused instruction. Understanding the challenges that JAMP students face with respect to foundational science content is essential for developing proficiency on the MCAT.

The Efficacy of Formative Assessment

While it seems reasonable to believe that identifying problems with student understanding and remediating against these problems would lead to student gains, it is important to understand the efficacy of this process known as formative assessment.

Black and William's widely cited 1998 review of the implementation of formative assessment in classrooms indicated that formative assessment had between a 0.4 to 0.7 effect on standardized assessments. This is equivalent to taking a student performing at the 50th percentile on a standardized assessment and moving them between the 66th percentile and the 76th percentile.

There has, however, been some debate about the magnitude of the impact of formative assessment on final, standardized measures (Kingston and Nash, 2011; Briggs et al., 2012). In fact, the range of improvement cited by Black and William's work above has been referred to as "urban legend" bysome researchers (Kingston and Nash, 2012). However, there still seems be a firm belief in its potential value to improving student proficiency in science. Even Kingston and Nash (2012) observed, "when more and better studies demonstrate a clear understanding of the factors that make formative assessment most effective, the effect sizes of well-designed studies of good formative assessment will be significantly higher, perhaps toward the upper range of the current urban legend."

What's the effectiveness of tutoring?

Another critical changeto the JAMP program was providing a select group of students with small-group tutoring for topics that were still difficult for them based on an analysis of their full-length practice tests in their MCAT preparation course. Benjamin Bloom (1984) in his review of the research conducted by several of his doctoral students found that human tutoring led to a two standard deviation increase in performance for tutored students relative to the gains made by students learning the same subject matter for the same duration of time in a conventional classroom setting where the student to teacher ratio was 30 to 1.

This is equivalent to taking a student performing at the 50th percentile on a standardized assessment and moving them to the98th percentile. The gain is almost unfathomable. Bloom characterized these tutors as good tutors. Cohen, Kulik and Kulik (1982) conducted a meta-analysis of achievement gains in 52 studies of human tutors in elementary and secondary schools in which tutors were peer or paraprofessional tutors (not “skilled” or “good” tutors necessarily). They found a gain in student achievement relative to conventional instruction of .4 standard deviations -equivalent to taking a student performing at the 50th percentile on a standardized assessment and moving them to the 66th percentile. These are still impressive results.

The research clearly indicates a benefit to students by implementing tutoring. The evidence of these gains, according to Graesser, et al (2011) tends to be higher for well-structured, precise domains (mathematics, physics) than for ill-structured domains (reading). That’s why we believed that the application of a tutoring program would be particularly effective for students focusing on difficult science topics.

Why is it important to monitor and respond to student performance?

Another important change to the program was the implementation of training for JAMP Faculty Directors to track and evaluate students’ progress, as well as motivate them to address any academic challenges they were facing. Our goal was to detect any early signs of problems with motivation so that JAMP mentors could help students re-engage with the course materials and be successful.

The Role of Motivation in an Academic Setting

One definition of motivation is that it is a process whereby goal-directed activity is started and sustained (Schunk, Pintrich, and Meece, 2008).If motivation is a process whereby activity is started and sustained,then motivational problems in the educational context may be thought of in terms of the factors that influence why students do not

- start new projects, start homework assignments, work through practice assignments
- finish projects or homework once they have been started
- put forth enough effort in taking on assignments and projects

Richard Clark in a 2011 presentation maintained that student beliefs about their ability to control the outcome of the effort they expend on their schoolwork influences whether they will start or finish projects or invest enough mental effort to get these projects done. If students' don't believe that it's worth expending the effort, then they won't.

Student beliefs about their ability to control the outcome of the effort they expend on their schoolwork tend to manifest themselves in terms of

- what school work students value
- what students attribute their success or failure on their assignments
- the emotions they have toward these assignments

Interventions to Address Motivational Challenges

Knowing that students attribute their lack of success to their lack of ability, as opposed to effort, provides the JAMP faculty directors an opportunity to challenge these beliefs and help students make better use of course materials. There are a number of motivation-focused interventions, which have had a positive impact on student achievement by challenging students to think about themselves, their coursework or their lack of success in different ways. One of these interventions involved students in college who were struggling academically. The intervention was designed to modify how students thought about their academic problems. Students in the intervention group watched videos of upper-year students describing how their grades in college were low at first but improved over time. These videos were intended to show students that the problems these students in the video had were not immutable, but fixable and transient. In a control group, students saw videos of the same upper-year students who talked about their interests and not their grades. Students who watched the videos in the intervention group performed better on a subset of GRE exam items. A year later, these students had earned higher college GPAs and were 80% less likely to have dropped out of college. Instead of thinking about their failures as an immutable problem, students came to see their original challenges as transitory in nature (Wilson and Linville, 1982).

Another of these noteworthy studies examined how students' theories about intelligence, a type of attribution, affected how much effort they invested in their work and ultimately how successful they were in their mathematics achievement. Blackwell (Blackwell et al., 2007) found that junior high school students who thought that their intelligence could be changed were more likely to believe that working hard was necessary and effective in achievement, than were students who thought that their intelligence was fixed. These students were more likely to make fewer helpless attributions when faced with the idea of setbacks and more likely to say they would invest more effort or change strategy when faced with challenges than were students who thought intelligence was a "you have it or you don't" situation. After controlling for initial levels of achievement in math, students who held a strong belief in the changeable nature of intelligence at the beginning of junior high school were outperforming those that did not hold this belief nearly 2 years later.

In a second study, these researchers found that providing students with workshops on the changeable nature of the human brain led to a reversal of the declining performance in math grades. The intervention led to a change in students' thinking about intelligence as well as a significant change in their grades following this 8-week, 8-session intervention.

Simple interventions that demonstrate the value of practice and that challenge students' beliefs about the immutability of intelligence can have a positive impact on student motivation and ultimately student performance as well.

Conclusion

Kaplan's application of learning science in the addition of formative assessment and intervention-based enrichment classes and tutoring to the JAMP program added significant value to student academic development and resulted in measurable improvement in MCAT scores, as well as a 14% increase in the medical school matriculation rate for JAMP participants. The evidence suggests that the Kaplan program for JAMP was successful in assessing and remediating student knowledge gaps early while keeping students motivated and engaged. This early and consistent intervention set the foundation for future success.

How Can Assessment & Intervention Work For Your Organization?

At Kaplan, we've not only seen success in the application of assessment and intervention programs in the academic world, but also in education and training programs for corporations, professional organizations, nonprofits, and government institutions. If you have any question on how these programs can work for your organization or would like a free consultation, our program specialists will happy to consult with you to develop a customized program that meets your needs.

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