Improving student learning and student retention at the undergraduate level

FINAL REPORT

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Collaborators (other departments, if any):
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Title of Your Proposal
Increasing Student Success in Elementary Statistics (Math 1070)

Theme of Your Proposal (Support for students; fostering connections; enhancing advisement; other innovations):

Digital Tutors for Weak and Struggling Students

College rating (approved; not approved) ____Approved___

Brief Summary of Outcomes

21 tutorials were created and provided to students in 15 randomly selected sections of Elementary Statistics in Spring 2009. The remaining sections were tracked as the control group. Attributes of participants by group are in Table1.

The students using tutorials were less likely to drop and more likely to pass than their classmates and control students. These results were even stronger when just examining the low achieving students. The low achievers who used tutorials scored better on exams than their low achieving counterparts in control sections. Higher achievers who used tutorials became more confident in their overall math ability than their high achieving classmates.

These tutorials are now available for loading into WebCT of every section of Elementary Statistics to permit all students wishing to use them to benefit. The tables supporting the working paper on this project are attached. As promised in the proposal, the working paper is currently being reviewed and will be submitted to a peer-reviewed journal in 2010 to create scholarly discussion of this form of supplemental instruction. The final paper will be forwarded when ready.

Conclusion of study

A high percent of low achievers, who often do not seek help in spite of needing it, used the tutorials and passed at much higher rates than their low achieving counterparts in control sections. The surveys showed that low achievers felt the resources were important to their achievement and the higher exam scores confirmed their self report. Remarkably, they used the tutorials as frequently as the higher achievers, even without course credit for the effort. The tutorials had their intended outcome: it got these typically poorly motivated students to exert effort and get their exam scores up.

Tutorial use was significant in explaining low achievers exam scores but not middle and high achievers. This reflected the low achievers' higher reliance on tutorials over other course resources. Although poorly motivated, low achievers will use convenient resources and learn enough to meet their low to moderate course grade goals.

Middle and high achieving students used the tutorials and reported that they were important to their course achievement but exam scores were not significantly related to tutorial use. Better achieving students had many other resources to use to increase exam scores

and likely were motivated enough to use them. Tutorial use, however, did help the better achievers in a different way--it increased their math self-concept. So the strategies, techniques and messages in the tutorials influenced their overall math confidence above their classmates.

This study offers great news to students, instructors and administrators who are often pressed for time and resources. A relatively modest resource, 21 short tutorials, decreased the drop rate, increased the pass rate and improved exam scores for at risk students. For students at the higher end of the grade curve, tutorials improved their self confidence in math.

The larger full-featured supplemental instruction programs generally target at-risk courses rather than at-risk students. These programs require extensive work to implement followed by annual hiring and training of tutors and coordination of many class sessions. While the full featured supplemental instruction programs have large learning advantages, when resources are scarce or local campus cannot implement a full model, an on-line tutorial set designed just for the at-risk population may be a great low maintenance one time investment in the battle to improve campus retention.

Evaluation Measures

The proposal committed to tracking:

1. Number of times each student used a Digital Tutor (see Table 2).
2. Survey of student impression of course resources (see Figure 2).
3. Exam scores before and after Digital Tutors. This was replaced with analyses of exam scores using HLM and regression (see Table 5 & 6).
4. Success rates on common departmental final exam questions on Digital Tutor topics. Most students completed the departmental final exam problem correctly so this aspect of data collection was dropped.
5. DWF rates for sections with and without Digital Tutors (see Table 3 and 4).

TABLE 1
Participant Attributes: Mean (Std. Dev.)

Attribute	Users[a]	Non-Users	Control
Number of participants	320	375	716
Percent female	58.4%	59.7%	58.4%
SAT verbal [b]	517.46 (70.40)	521.77 (77.03)	521.09 (74.84)
SAT math [b]	525.17 (73.09)	527.30 (72.73)	527.06 (76.00)
Cumulative GPA [c]	2.93 (0.65)	2.85 (0.81)	2.83 (0.78)
College credit hours earned ($p < .05$)	69.40 (35.12)	62.11 (35.64)	65.74 (34.33)
Had previous statistics class	19.0%	22.1%	16.8%

[a] Opened two or more tutorials during term.
[b] Excludes transfer students, for which SAT scores are not required (n = 430, 54 non-users, 138 users and 238 control).
[c] Includes 11 newly transferred students who withdrew from all their classes leaving no GPA so their transfer GPA was used.

TABLE 2
Participation and Student Goals by Achievement Level for Students with Access to Tutorials: Mean (Std. Dev.)

Attribute	Cumulative GPA		
	Low: < 2.4	Middle	High: > 3.4
Participants with access to tutorials	168	339	188
Participants using tutorials [a]	66	173	81
Percent using tutorials [a] ($p < .05$)	39.3%	51.0%	43.1%
Percent using advanced tutorials	31.3%	29.2%	26.1%
Percent reporting goal as satisficing ($p < .001$)	63.0%	43.4%	24.6%
Average number of tutorials used	13.03 (12.5)	10.15 (9.2)	9.16 (8.9)

[a] Opened two or more tutorials during term.

TABLE 3
Drop Rates and Pass Rates by Group: Mean (Std. Dev.)

Attribute	Users[a]	Non-Users	Control
Number of participants	320	375	716
Number of students who dropped	29	69	116
Percent of students who dropped ($p <$ .01)	9.1%	18.4%	16.2%
Number of students passing (Grade A, B or C)	266	273	542
Percent passing (Grade A, B or C) (p < .01)	83.1%	72.8%	75.7%
Exam 1 score	78.90 (16.32)	78.86 (17.41)	80.32 (16.38)
Exam 2 score	81.08 (15.35)	80.55 (16.76)	81.00 (15.67)
Exam 3 score	77.88 (18.50)	79.46 (18.67)	79.08 (17.81)
Exam 4 score	79.81 (19.34)	78.59 (18.24)	80.67 (19.15)
Final exam score	79.52 (13.56)	79.99 (16.84)	80.67 (14.98)
Attended on both survey dates ($p <$ .001)	35.0%	22.4%	27.5%
Percent reporting goal as satisficing [b]	39.0%	39.5%	36.6%

[a] Opened two or more tutorials during term.

[b] Excludes students absent on end-of-semester survey date (n = 627, 185 non-users, 125 users and 317 control).

TABLE 4
Drop Rates and Pass Rates for Low Achievers: Mean (Std. Dev.)

Attribute	Users[a]	Non-Users	Control
Number of low achievers	66	102	189
Low achievers who dropped	12	38	63
Percent of low achievers who dropped (p < .05)	18.2%	37.3%	33.3%
Number of low achievers passing (Grade A, B or C)	42	37	84
Percent passing (Grade A, B or C) ($p <$ .01)	63.6%	36.3%	44.4%
Attended on both survey dates	27.3%	12.8%	22.9%

[a] Opened two or more tutorials during term.

TABLE 5
Longitudinal Analysis of Change in Exam Scores with Tutorial Use

	Model 1: Intercept		**Model 2: + week**	
Fixed Effects:	**coeff.**	**s.e.**	**coeff.**	**s.e.**
Intercept	79.18***	0.714	81.15***	1.369
Week			-0.18	0.099
Tutorial use[a]				
GPA[a]				
Math SAT[a]				
Total credit hours [a]				
Variance:				
Level 1				
Within person[#]	143.46		136.75	
Level 2				
Between persons in initial status	136.86***		103.56***	
Between persons in growth			0.02	
Level 3				
Between instructors in initial status	6.83***		30.81***	
Between instructors in growth			0.16***	

* p < 0.05
** p < 0.01
*** p < 0.001
# There is no significance test in HLM for the within person variance.
[a] Because the slope for week was insignificant, adding variables to explain slope would not improve the model so these variables were not added to the model.

TABLE 6
Exam Average as a Function of Tutorial Use

Panel A: Low, middle and high achievers

Variable	*B*	*Std. Error*	*β*	*t*	*Sig.*
Constant	23.133	3.762		6.150	0.000
Tutorial views	0.103	0.073	0.038	1.411	0.159
Total credit hours	0.044	0.016	0.075	2.775	0.006
Cumulative GPA	13.611	0.682	0.551	19.961	0.000
Math SAT	0.023	0.006	0.098	3.547	0.000

Model R^2 = .340

Panel B: Only low achievers

Variable	*B*	*Std. Error*	*β*	*t*	*Sig.*
Constant	20.393	10.198		2.000	0.047
Tutorial views	0.379	0.158	0.161	2.407	0.017
Total credit hours	0.039	0.047	0.059	0.835	0.405
Cumulative GPA	12.051	3.090	0.270	3.901	0.000
Math SAT	0.033	0.016	0.138	2.026	0.044

Model R^2 = .141

TABLE 7
Self-Efficacy Measures and Survey Data: Mean (Std. Dev.)

Attribute	Users[a]	Non-Users	Control
Completed beginning of course survey	265	281	567
Completed end of course survey	196	189	396
Beginning math self-concept [d]	1.85 (0.79)	1.91 (0.77)	1.83 (0.81)
Ending math self-concept [d]	1.82 (0.81)	1.99 (0.85)	1.91 (0.81)
Beginning statistical self-efficacy [d]	3.86 (1.29)	3.98 (1.33)	3.89 (1.25)
Ending statistical self-efficacy [d]	4.28 (0.85)	4.39 (0.96)	4.32 (0.94)
Had previous statistics class	37	42	67

[a] Opened two or more tutorials during term.
[d] A higher number equals a higher level of confidence.

TABLE 8
Self-efficacy by Achievement Level: Mean (Std. Dev.)

Attribute	Cumulative GPA		
	Low: < 2.4	Middle	High: > 3.4
Beginning Math Self-concept [b] ($p < .001$)	1.85 (0.78)	1.78 (0.81)	2.07 (0.71)
Ending Math Self-concept [b] ($p < .001$)	1.81 (0.66)	1.77 (0.85)	2.12 (0.83)
Beginning Statistical Self-efficacy [b]	3.74 (1.17)	3.96 (1.28)	3.98 (1.43)
Ending Statistical Self-efficacy [b] ($p < .001$)	3.89 (0.91)	4.26 (0.88)	4.57 (0.87)
Change in average Math Self-concept	-0.04	-0.01	0.05
Change in average Statistical Self-efficacy ($p < .05$)	0.15	0.30	0.59

[a] Opened two or more tutorials during term.
[b] A higher number equals a higher level of confidence.

TABLE 9
Change in Math Self-concept and Change in Statistical Self-Efficacy

Panel A: Ending Math Self-concept as a function of level of tutorial use

	Type III SS	***df***	***Mean Square***	**F**	***Sig.***
Beginning math self concept	143.502	1	143.502	524.751	0.000
Cumulative GPA	2.185	1	2.185	7.992	0.005
Tutorial use	1.077	1	1.077	3.937	0.048
Total credit hours	0.006	1	0.006	0.023	0.879
Math SAT	1.411	1	1.411	5.160	0.024
Group (user, non-user, control)	0.070	2	0.035	0.129	0.879

Model R^2 = .603

Panel B: Ending Statistical Self-efficacy as a function of level of tutorial use

	Type III SS	***df***	***Mean Square***	**F**	***Sig.***
Beginning statistical self efficacy	35.159	1	35.159	52.069	0.000
Cumulative GPA	14.185	1	14.185	21.007	0.000
Tutorial use	0.039	1	0.039	0.058	0.810
Total credit hours	1.129	1	1.129	1.672	0.197
Math SAT	5.057	1	5.057	7.489	0.006
Group (user, non-user, control)	2.595	2	1.297	1.921	0.148

Model R^2 = .603

TABLE 10
Course Resources Reported As Important to Achievement: Count (Percent)

Attribute	Users[a]	Non-Users	Control
Completed end of course survey	196	189	396
Lecture	89 (45.5%)	127 (67.2%)	274 (69.2%)
Course notes provided by instructor	42 (21.4%)	48 (25.4%)	118 (29.8%)
Digital Tutors	111 (56.6%)		
Math Assistance Center (Math Lab)	10 (5.1%)	22 (11.6%)	28 (7.1%)
Office Hours	16 (8.2%)	17 (9.0%)	50 (12.6%)
Course textbook	95 (48.5%)	98 (51.9%)	205 (51.8%)
Course website resources	14 (7.1%)	10 (5.3%)	18 (4.5%)

[a] Opened two or more tutorials during term.
[d] A higher number equals a higher level of confidence.

TABLE 11
Low Achievers Only
Course Resources Reported As Important to Achievement: Count (Percent)

Attribute	Users[a]	Non-Users	Control
Completed end of course survey	31	23	70
Lecture	14 (45.2%)	14 (60.1%)	46 (65.7%)
Course notes provided by instructor	0	0	0
Digital Tutors	19 (61.3%)		
Math Assistance Center (Math Lab)	3 (9.7%)	3 (13.0%)	6 (8.6%)
Office Hours	4 (12.9%)	3 (13.0%)	12 (26.1%)
Course textbook	15 (48.4%)	14 (60.9%)	33 (47.1%)
Course website resources	1 (3.2%)	1 (4.3%)	3 (4.3%)

[a] Opened two or more tutorials during term.
[d] A higher number equals a higher level of confidence.

Figure 1
Tutorial Use by Topic in Order of Course Syllabus

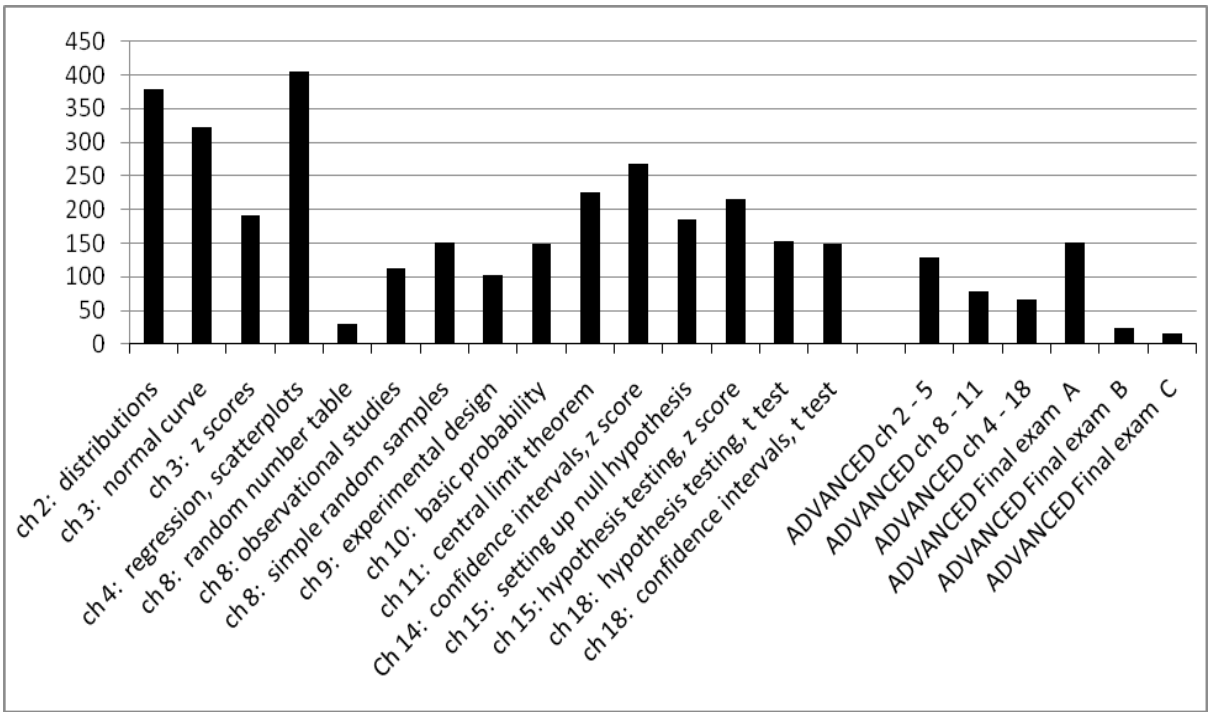

Figure 2

Best Features of Tutorials as Reported by Users