



Tennessee Board of Regents

Office of the Vice Chancellor for Academic Affairs

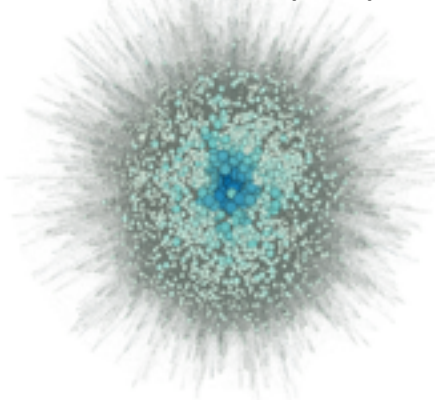
Student Success, Curricular Structure and Course Revitalization

A system as diverse as the Tennessee Board of Regents must teach a vast array of coursework to meet the curricular requirements of all of its programs of study. In fact, each semester the system's roughly 200,000 students study over 8000 different courses. However, more than half of the one-million student-course enrollments lie in around thirty of those classes. This observation in no way implies that the other 7970 courses have no role to play, or that we need far fewer courses – if anything we probably need yet more. But it does point to a peculiarity of curricular structure: course enrollment is highly concentrated.

Over the last 15 years there has been a growing understanding of the structure of complex networks (Watts, Duncan J., & Strogatz, Steven H. 1998; R. Albert, R. & Barabasi A.-L., 2002). These small-world networks can be used to analyze a wide range of systems in nature, technology and societal phenomena from the world wide web to virus spread. One feature of this type of network is the existence of hub vertices – nodes in the network with an over abundance of connections. These hubs play a disproportionately large role in the connective structure of the overall network, both enabling effective flow around the network, and also fragmenting the network when they are damaged or removed (Albert, R., Jeong, H. & Barabasi, A.-L., 2000; Pastor-Satorras, R. & Vespignani, A., 2001).

By studying the course transcripts of graduates across the system we were able to establish that the system's course structure is itself a small-world network. The highly enrolled classes that comprise the lion's share of the enrollment are the hubs in this network. But consequently, as well as being highly enrolled they also play a disproportionately critical curricular role in the overall learning structure of the system – successful learning in these classes disproportionately leads to further success; lack of success in these classes leads to failures elsewhere.

Graduate-Transcript Graph



This graph is formed by analyzing the transcripts of all TBR graduates since 2006. The vertex set is the set of all courses taken. An edge joins two courses that appear together on a graduate's transcript. In the diagram, the bigger and bluer the vertex, the higher the vertex degree.

The structural curricular analysis suggests that improvement in student learning in these “hub” classes will reach across the student body very quickly, and will also influence student success across the breadth of the curriculum. This analysis has informed a variety of approaches to help improve student learning.

This year we began an initiative to increase accessibility to instructional materials for students with disabilities. To ensure maximum impact we applied this logic of impacting “hub” classes. We trained faculty representatives, from each of the top 30 classes at each institution, to apply an accessibility rubric to the delivery of their class. The combined data from these analyses has enabled a coordinated system approach to increasing accessibility that has recently been recognized with an award from the National Federation of the Blind¹, and has also enabled faculty in each course to frame accessibility implementation plans for their courses.

This small-word graph approach has also informed our Course Revitalization Initiative, in which teams of faculty at institutions develop new and more effective pedagogies for exactly these most curricularly impactful classes. Beginning in Fall 2013 we invited teams of faculty from across the system to propose a re-envisioned structure for one of these highly impactful classes on their campus. They were asked to propose a new approach, together with a proposed assessment structure, with the intention that they would be able to establish that in this new format more students would learn more material more deeply, and consequently would be more successful in that class. Support was to be provided for the successful teams from funds provided by the system office, as both recognition and incentive for the work to be done. We had over 120 team proposals and were able to fund 53 projects spanning the curricular spectrum. The selected teams implemented their pilots and collected their data during Fall 2014. The projects involved over 14,000 students and 160 faculty at 18 campuses, in courses from 16 disciplines. Faculty designed new course structures from the full spectrum of contemporary techniques, including supplementary instruction, learning communities, flipped and hybrid classroom models as well as using technologies in variety of learning settings.

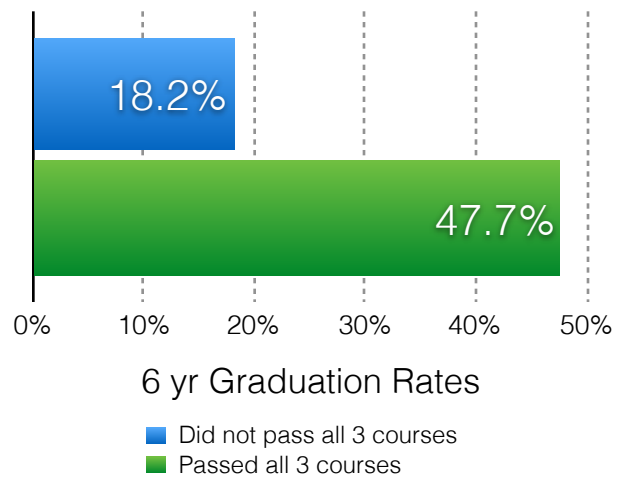
In Fall 2014, we also invited a new set of proposals that furthered the work with 36 new pilot projects the following Fall semester, whilst enabling 6 of the original set to go to a full scale. In Fall 2016, 14 new projects are carrying out their pilot work, and 15 of the earlier projects are being taken to full scale.

The revitalization projects fell into two broad categories: co-requisite remediation and gate-way class redesign. Thirty-three were part of our system-wide pilot and subsequent implementation of co-requisite remediation. This work led to an increase from 12 percent to 55 percent in the success rates of community college students who began in developmental mathematics and passed a credit bearing mathematics class in their first academic year, and an increase from 31 percent to 62 percent in the similar success rate of those community college students who began in developmental writing. These gains were achieved across the full student population, with substantial gains for students of every preparation level and sub-population. There were also significant gains in the university sector. The results of the pilot and full implementation of the co-requisite remediation are fully discussed in the technical reports on that topic (see Denley 2015 and 2016).

¹ Dr. Denley was awarded the 2016 Newel Perry Award for this work.

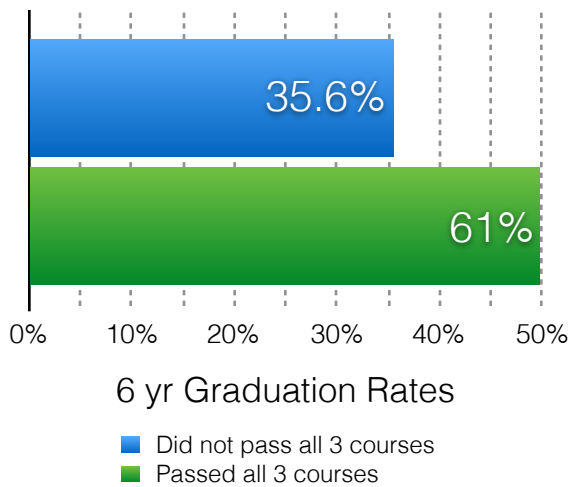
The remaining 56 projects were revitalizations of gate-way classes other than Mathematics and English from the top 30 classes. While not every new approach was as successful as originally planned, 25 of the projects produced results with increased student success rates in comparison with their comparator groups. That increase was statistically significant for 18 of those projects, often strikingly so. The purpose of these pilots was to identify successful new pedagogies. Twenty-one of the projects will have taken their new model to a full-scale by Fall 2016. We continue to gather data about the success of those scaled projects, as well as identify ways in which the system can help

The Effect of Math and Writing Success in the First Year on Community College Graduation Rates



provide support or pathways to overcome roadblocks that would enable this work to scale more fully.

The Effect of Math and Writing Success in the First Year on University Graduation Rates

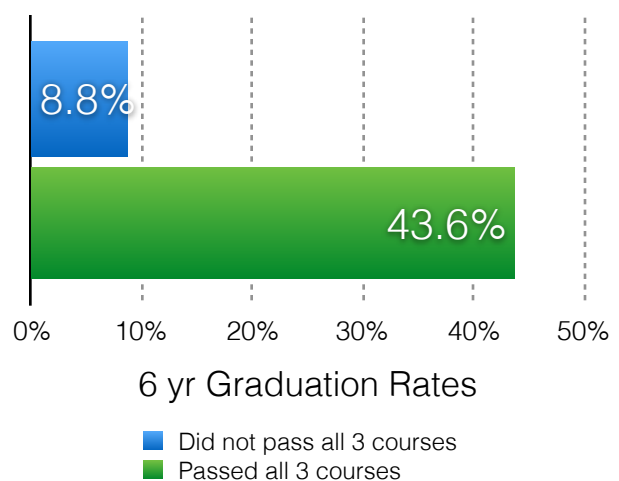


As we mentioned in a small-world network, the hubs play an extremely important role in the structure of the graph, fragmenting the network when they are damaged or removed (Albert, R., Jeong, H. & Barabasi, A.-L., 2000; Pastor-Satorras, R. & Vespignani, A., 2001). One demonstration of this effect on the curricular structure is the pivotal role of English Composition I, II and general education Mathematics.

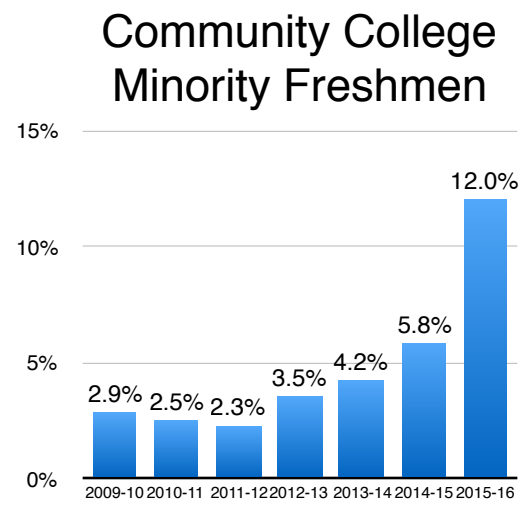
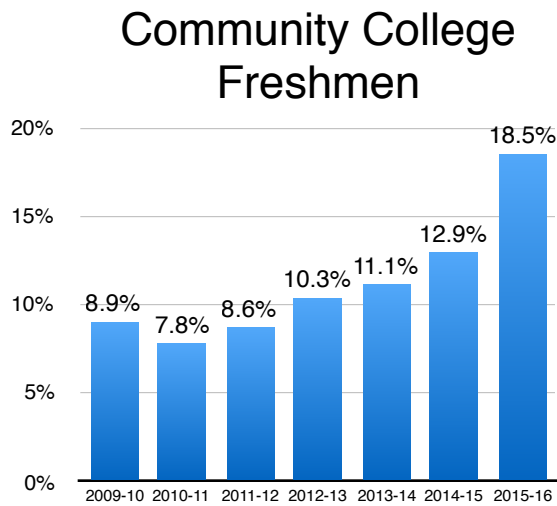
These courses are amongst the most powerful hubs in the graduate-transcript graph. Consequently we analyzed the influence on graduation rate when a student does or does not complete all three courses in their first academic year.

The effect is clear. In both the university and community college sectors, those students who were able to earn passing grades in these fundamental classes during their first academic year had significantly higher

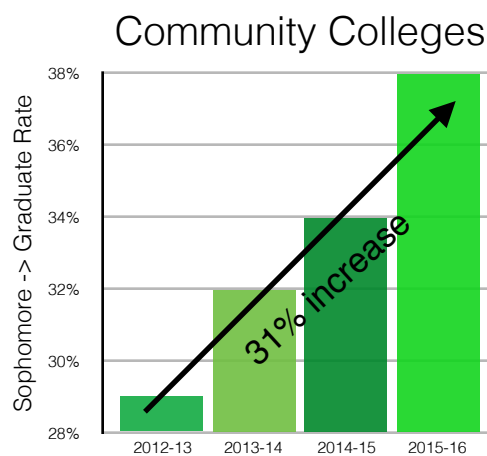
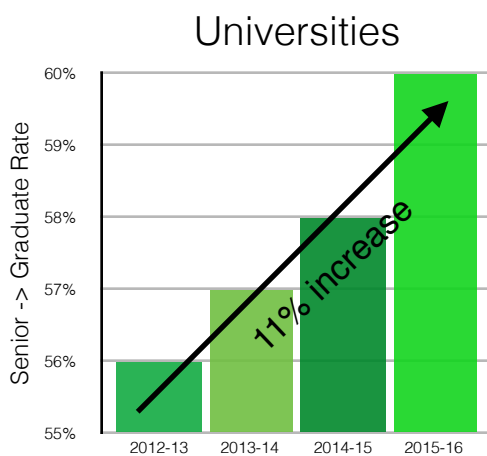
The Effect of Math and Writing Success in the First Year on Community College Graduation Rates for Minority Students



graduation rates than their counterparts who did not. Indeed the margins are even greater for minority students, with an increase from 8.8 percent to 43.6 percent for community colleges students and from 23.6 percent to 55.1 percent for university students.



Thankfully, the implementation of system-wide co-requisite remediation together with the course revitalizations have significantly increased the proportions of students who are completing their writing and mathematics classes. While there is still progress to be made, we have already seen an 11 percent increase in the university setting since 2012-13, from 28.2 percent to 31.2 percent, and an 80 percent increase in the community colleges. Again the increases are even more striking for minority students, with a 24 percent increase for university students, and a 240 percent increase in the community colleges.



It is certainly too early to see the impact of these changes on 6 year graduation rates, although the early indicators that we have already examined suggest that we will see those increases. That said, we have already seen an 11% increase in university seniors who graduate within that academic year and 31% increase in Community College sophomores who graduate within a year.

For further information concerning this study or other student success initiatives in the Tennessee Board of Regents contact Dr. Tristan Denley, Vice Chancellor for Academic Affairs, tristan.denley@tbr.edu

References

1. Watts, Duncan J., & Strogatz, Steven H. (1998). "Collective dynamics of 'small-world' networks". *Nature* **393** (6684): 440–442
2. Pastor-Satorras, R. & Vespignani, A., 2001, Epidemic spreading in scale-free networks, *Phys. Rev. Lett.*, 86, 3200 (2001)
3. Albert, R., Jeong, H. & Barabási, A.-L. Error and attack tolerance of complex networks. *Nature* 406, 378-382 (2000)
4. R. Albert, R. & Barabási A.-L., Statistical mechanics of complex networks. *Rev. Mod. Phys.* 74, 47–97 (2002)
5. Denley, T. 2014. How predictive analytics and choice architecture can improve student success. *Research & Practice in Assessment*. 9, 2. 61-69.
6. Denley, T., (2015) Co-requisite Remediation Pilot Study, Tennessee Board of Regents
7. Denley, T., (2016) Co-requisite Remediation Full Implementation 2015-16, Tennessee Board of Regents
8. Jenkins, D., Jaggars, S.S., & Roksa, J. (November 2009). *Promoting Gatekeeper Course Success Among Community College Students Needing Remediation: Findings and Recommendations from a Virginia Study (Summary Report)*. Community College Research Center, Teachers College, Columbia University, pp. 2-3.