Visualizing Student Pathways:

Curricular Analytics

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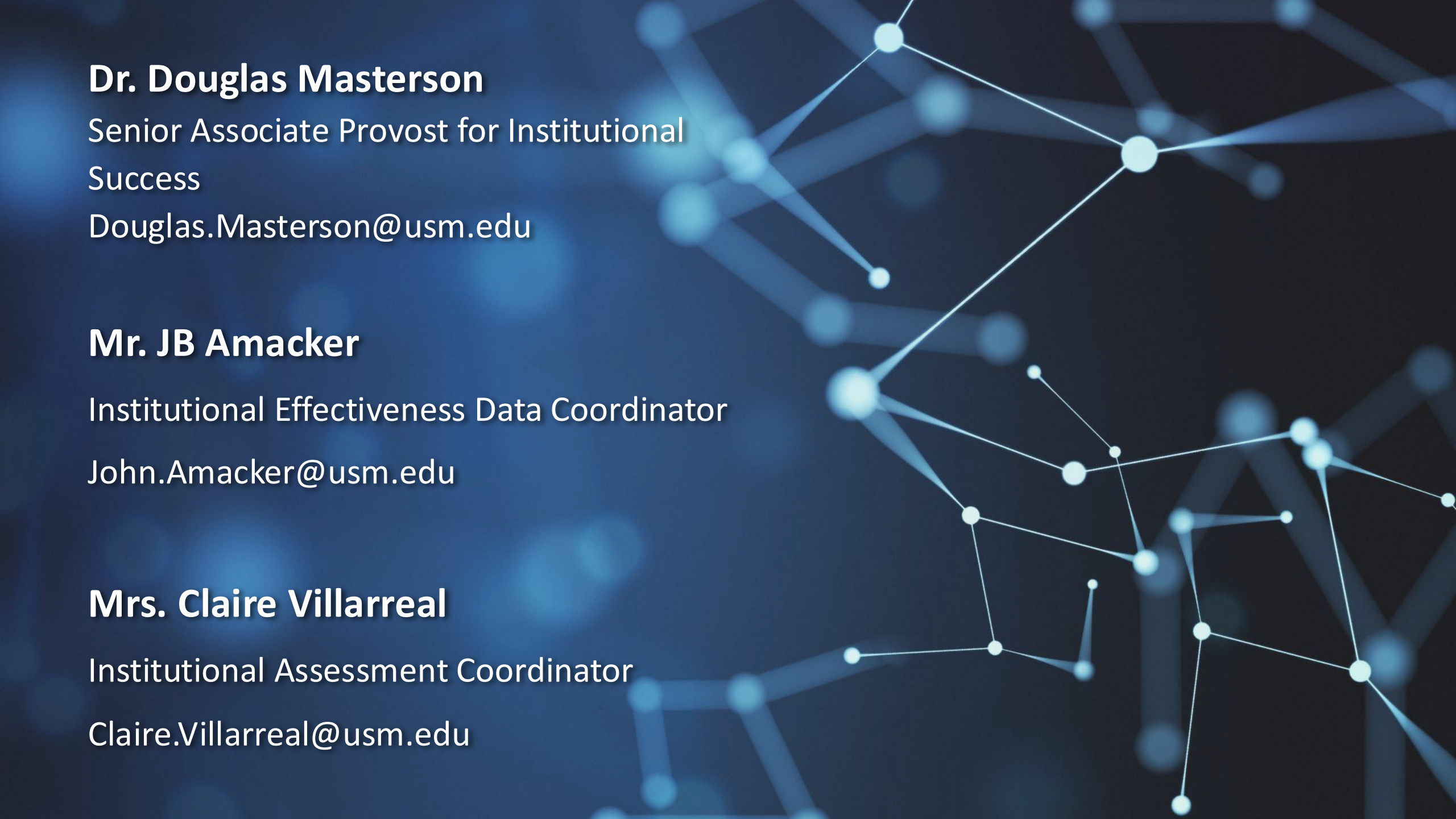


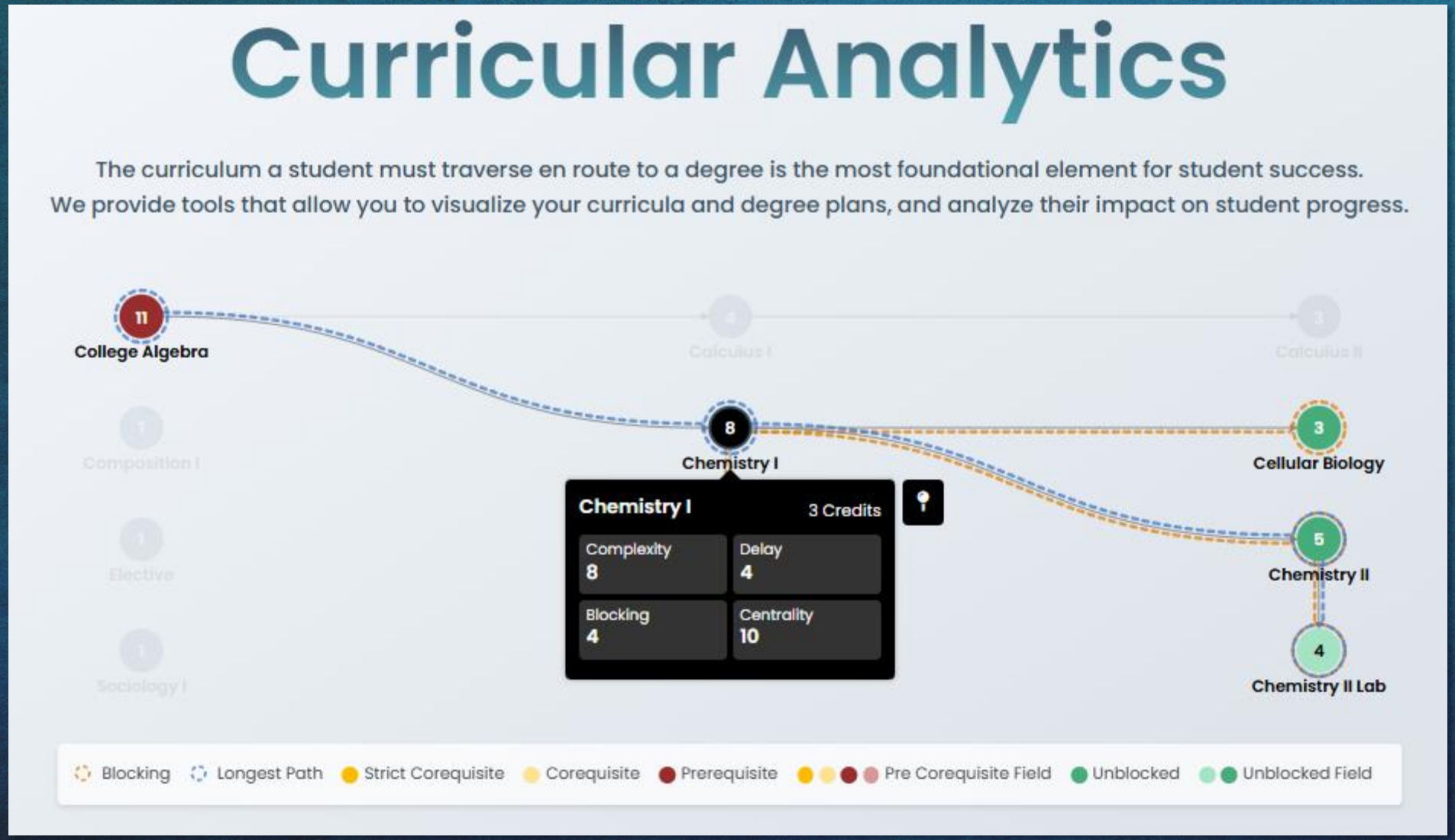
Questions?

Questions will be answered from the above Q&A.

What is Curricular Analytics?

- An open-source (free) platform.
- A tool that helps analyze and visualize curricula.
- Can be used to assess the ***complexity*** of academic programs.
  - Helps identify courses that may delay a student's progress towards graduation.
  - The higher the complexity, the harder it is for students to graduate on time.

www.curricularanalytics.org/home



Visualize

Simply store a curriculm or degree plan in a spreadsheet using our easy-to-use csv template, upload it, and you'll recieve a beautiful interactive visualization like the one shown above.

Analyze

The overall complexity of an uploaded curriculum or degree plans is automatically analyzed, and various metrics associated with the individual courses in the curriculum are provided. Learn more about these metrics.

Catalyze

Use these analytics to foster data-informed conversations around student success, curricular complexity, and optmized degree plans. To view curricular studies that have been used to catalyze change, visit the Curricular Analytics Notebooks site.

Origins of Curricular Analytics

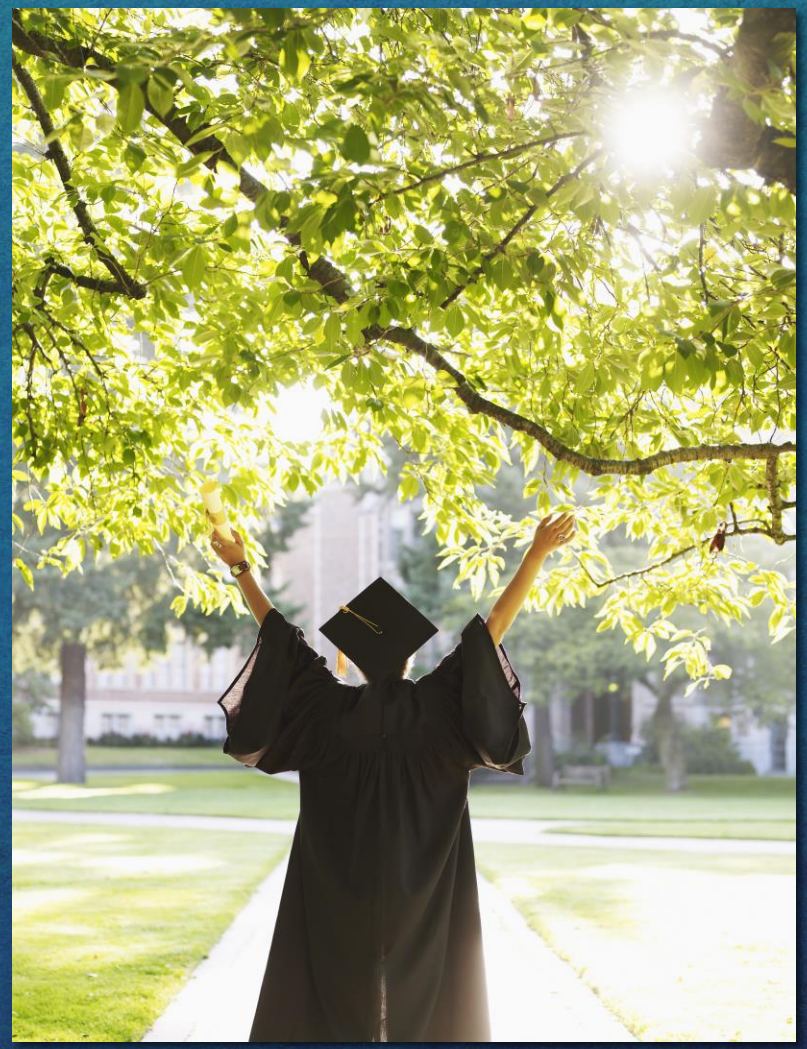
Heileman, G. L., Abdallah, C. T., Slim, A., & Hickman, M. (2018). *Curricular analytics: A framework for quantifying the impact of curricular reforms and pedagogical innovations.* arXiv. https://arxiv.org/abs/1811.09676

This paper introduced the concept of Curricular Analytics, providing the first quantitative framework to evaluate how curriculum design influences student success.

Origins of Curricular Analytics

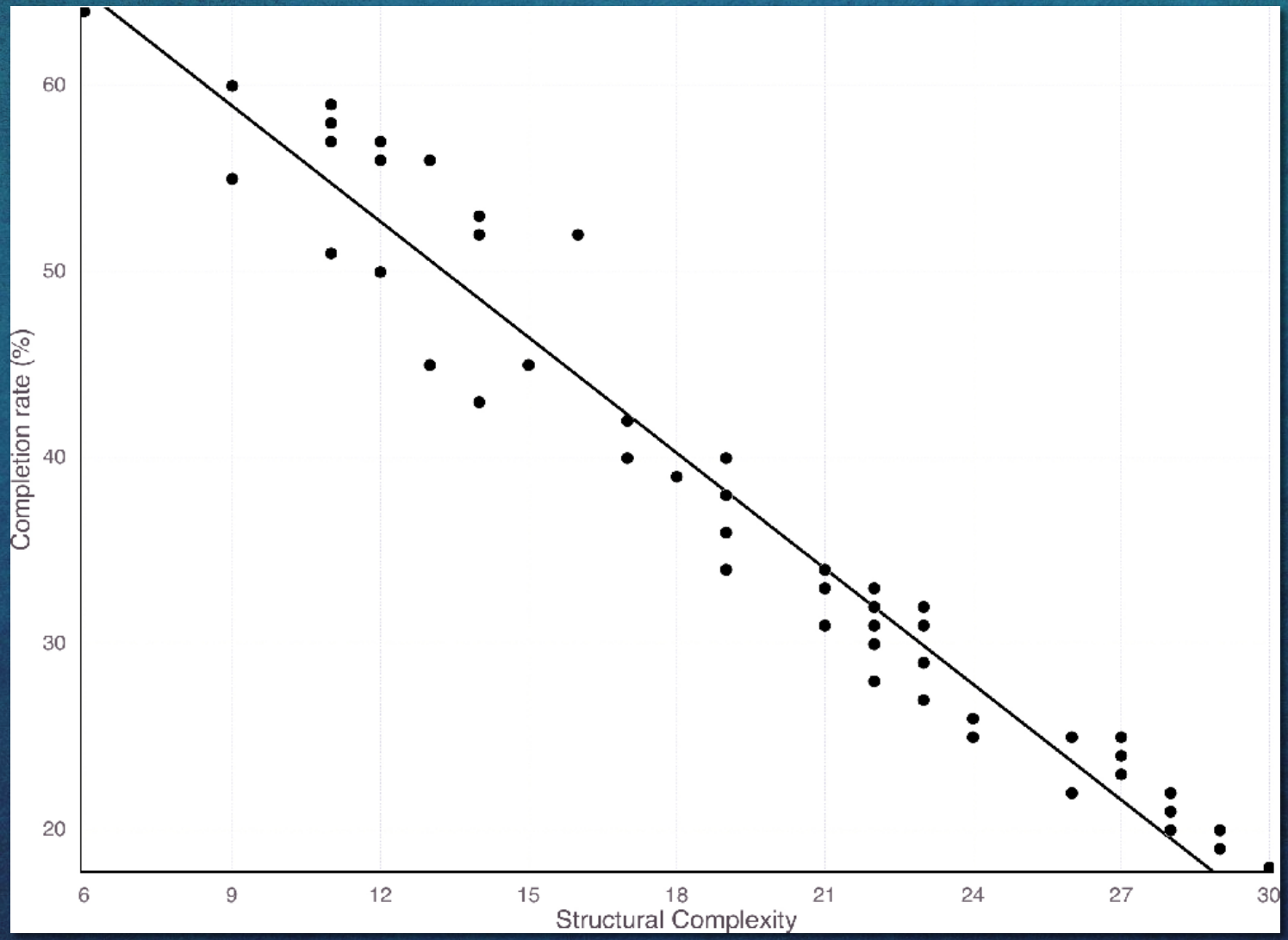
The authors argued that ***progression through the curriculum***—not demographics or isolated interventions—***is the core of student achievement***.

They modeled curricula as directed acyclic graphs (courses as nodes, prerequisites as edges), allowing ***complexity to be measured mathematically***.



Origins of Curricular Analytics

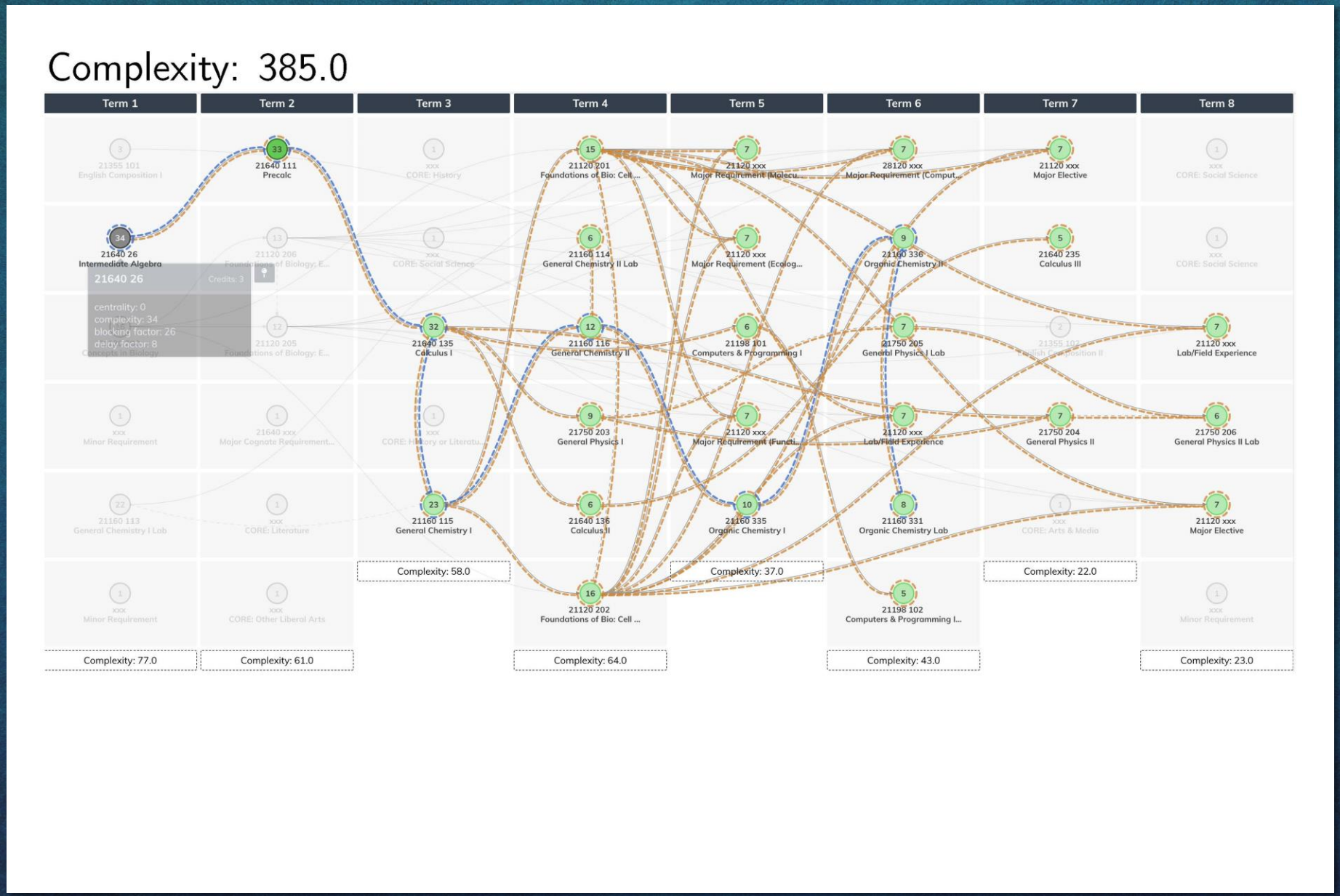
Through simulations, they demonstrated that curricula with longer prerequisite chains and key “blocking” courses produce lower graduation rates, ***even when instructional quality is constant***.



Origins of Curricular Analytics

Their model became the basis for modern curricular analytics tools. The study established Curricular Analytics as a ***predictive, data-driven method*** for comparing, reforming, and improving academic programs ***by linking curriculum structure directly to student outcomes.***

Live Demo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Complexity: 23.0

About the Numbers…

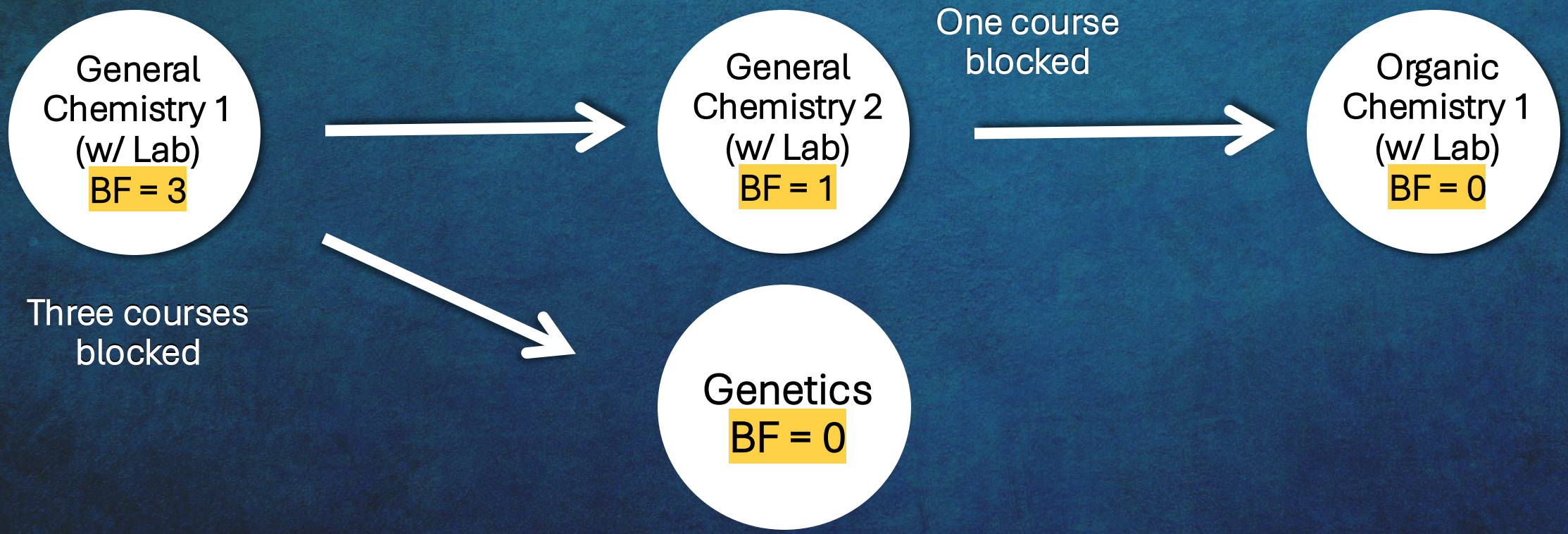
Just like in golf, the lower a “score” in Curricular Analytics, the better!

Curricular Analytics measures blocking factor, delay factor, centrality, and complexity. The higher that each of these are, the higher the structural challenges are for students to graduate on time.

Blocking Factor

The extent to which one course blocks the ability to take other courses in the curriculum.

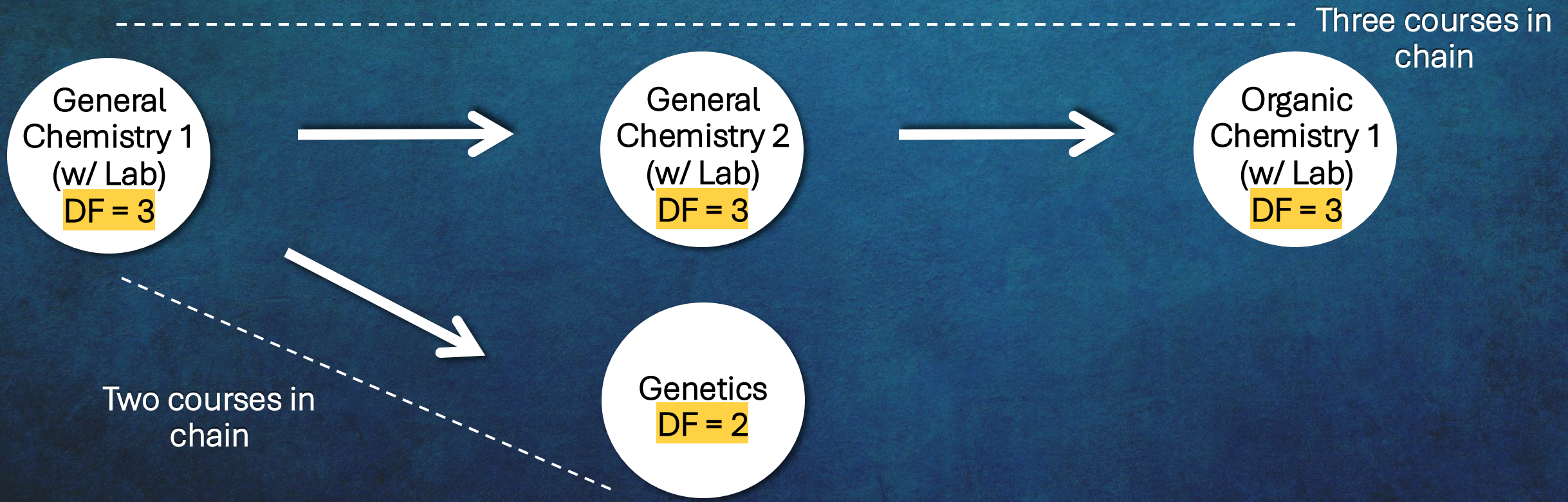
- A course with a high blocking factor acts as a gateway to other courses in the curriculum.
- Students who are unable to pass the gateway course will be blocked from taking many other courses in the curriculum.



Delay Factor

For a set of courses that must be completed in sequential order, the impact of not completing a course on time, thus delaying a student's completion of an entire pathway.

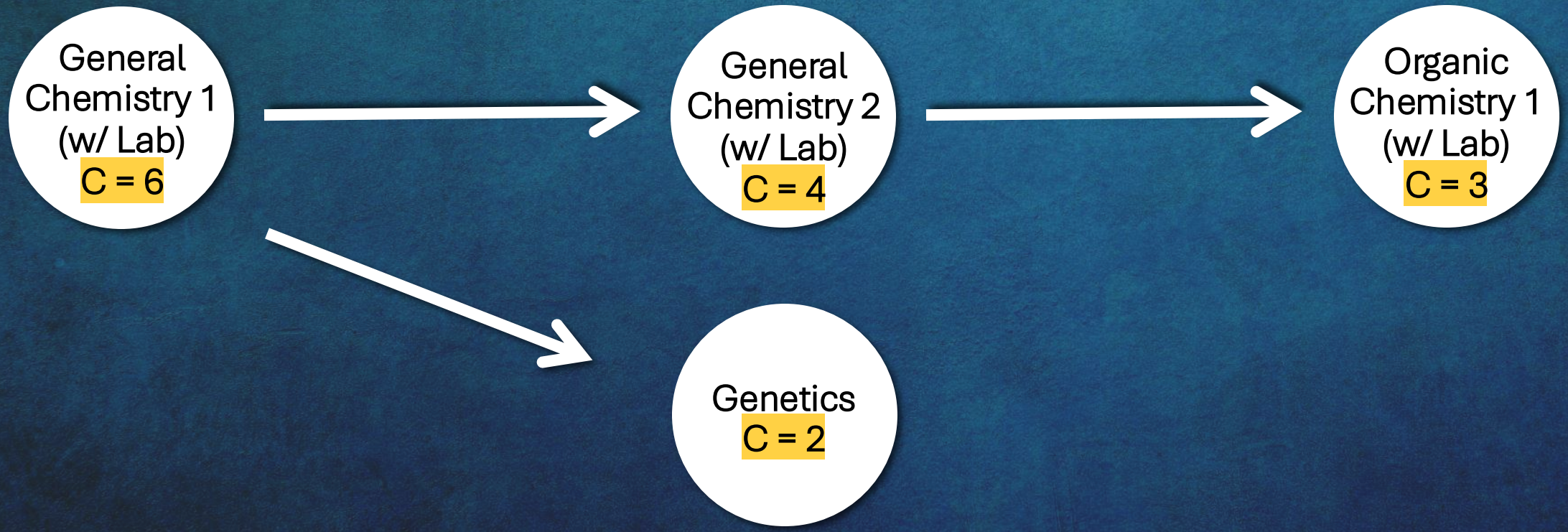
- The ability to successfully navigate long pathways without delay is critical for student success and on-time graduation.
- ***Calculated for the entire "chain" of courses, not course by course.***



Course Complexity

The ***combination*** of ***delaying and blocking*** factors in a curriculum.

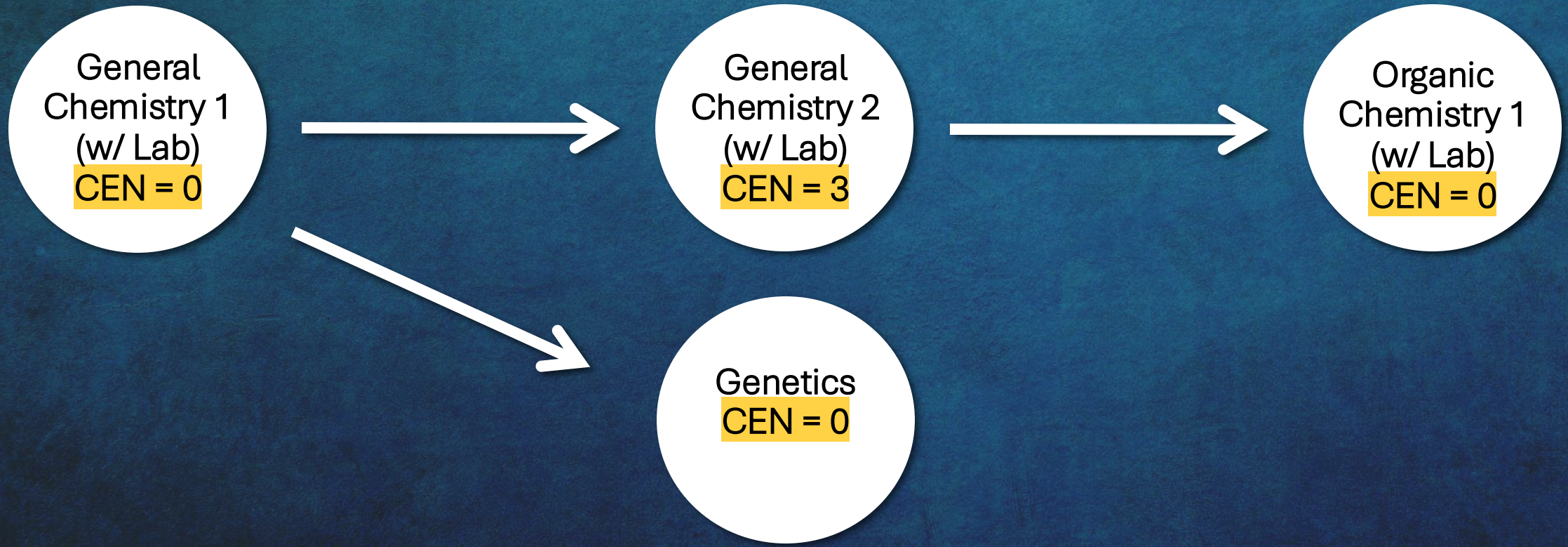
- Captures the impact of curricular structure on student progression.
- There is a high correlation between ***structural complexity*** and graduation rates (i.e., the higher the structural complexity, the lower the graduation rates).



Centrality

The extent to which a course is central to degree progression.

- Courses that require several foundational courses as prerequisites ***AND*** serve as a prerequisite to several discipline-specific courses.
- CEN = ***sum of all "path" lengths*** for a course that requires prereqs and is itself a prereq



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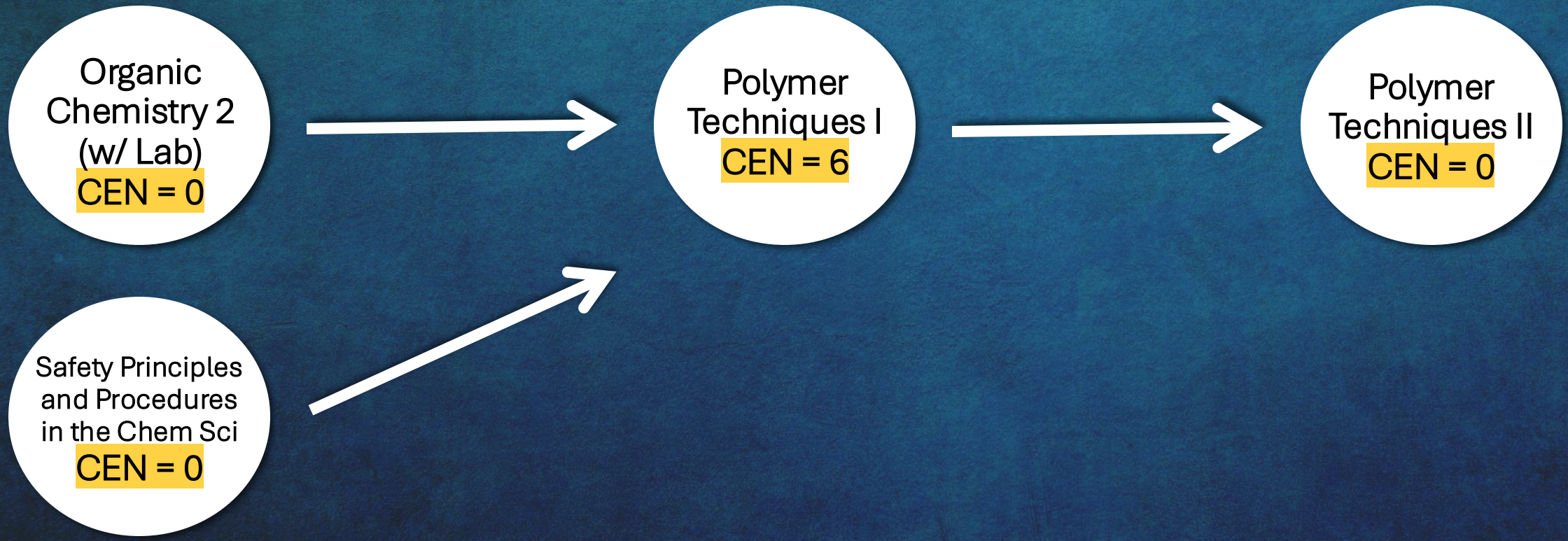

How are the visualizations created?

The Office of Institutional Effectiveness reviews degree plans in the bulletin and creates the CSV files.

- Any course ordering or requirements not listed in bulletin are not captured.
- When degree plans reference elective options, we code that requirement as an elective and do not enter pre-reqs.
  - If you know a certain course is far more common that other options, we can build a view with that course in place of the elective range.
- The system allows us to place notes / comments in each course's cell. This means we can overlay other campus data (DFW rates, etc.) on top of complexity charts.

Curriculur	Chemistry (ACS) BS Calculus									
Institutior	University of Southern Mississippi									
Degree Ty	BS									
System Ty	semester									
CIP	40.0501									
Courses										
Course ID	Course Na	Prefix	Number	Prerequisi	Corequisit	Strict-Core	Credit Hou	Institutior	Canonical Name	
1	Compositi	ENG	101				3	USM	ENG 101	
2	Compositi	ENG	102				3	USM	ENG 102	
3	General Cl	CHE	106				3	USM	CHE 106	
4	General Cl	CHE	106L			3	1	USM	CHE 106L	
5	General Cl	CHE	107	4			3	USM	CHE 107	
6	General Cl	CHE	107L			5	1	USM	CHE 107L	
7	World Lite	ENG	203				3	USM	ENG 203	
8	History Ele	HIS	XXX				3	USM	HIS XXX	
9	Humanitie	Elec	XXX				3	USM	Elec XXX	
10	Aesthetic '	Elec	XXX				3	USM	Elec XXX	
11	Social and	Elec	XXX				3	USM	Elec XXX	
12	Social and	Elec	XXX				3	USM	Elec XXX	
13	College Al	MAT	101				3	USM	MAT 101	
14	Physical C	CHE	461	6;41;37;1;2			3	USM	CHE 461	
15	Physical C	CHE	461L			14	1	USM	CHE 461L	
16	Speaking I	CMS	XXX				3	USM	CMS XXX	
17	Research	CHE	496	1;2;29			3	USM	CHE 496	
18	Foundatic	CHE	108				1	USM	CHE 108	
19	Organic C	CHE	255	6			3	USM	CHE 255	
20	Organic C	CHE	255L			19	1	USM	CHE 255L	
21	Organic C	CHE	256	20			3	USM	CHE 256	
22	Organic C	CHE	256L			21	1	USM	CHE 256L	
23	Chemistry	CHE	308	22			1	USM	CHE 308	
24	Analytical	CHE	311	20			3	USM	CHE 311	
25	Analytical	CHE	311L			24	2	USM	CHE 311L	

How are the visualizations created?

- Some degree plans allow 3-12 hours in a foreign language, so we create a 3- and 12-hour version.
- For degree plans that require calculus, we create an Algebra- and Calculus-Ready version.
  - This is because some students may not need the College Algebra prereq for Calculus if their ACT score is high enough.

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23	Chemistry	CHE	308	22			1	USM	CHE 308	
24	Analytical	CHE	311	20			3	USM	CHE 311	
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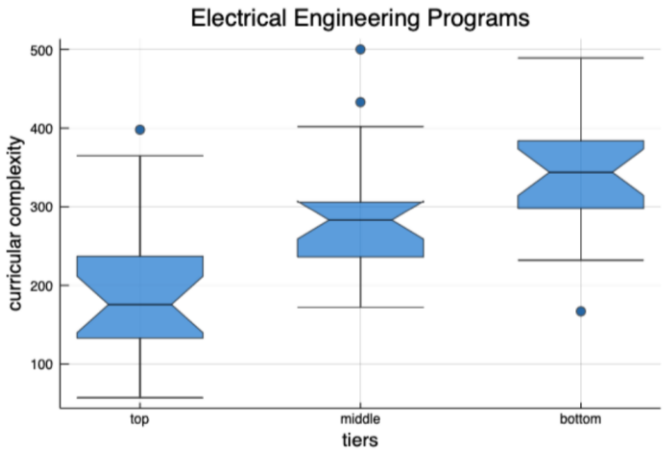
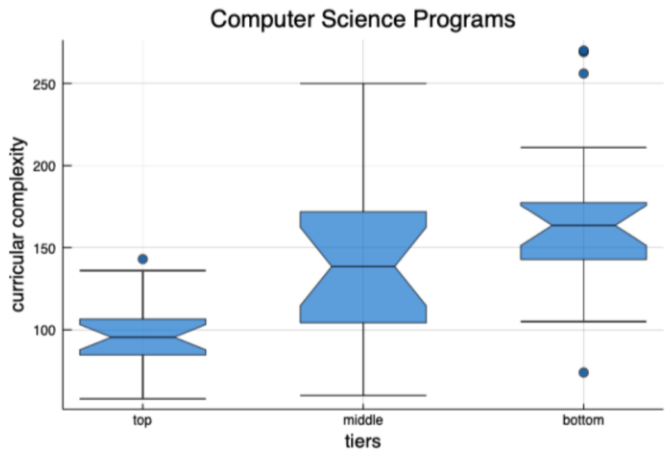
Complexity vs. Quality

Do higher quality programs have higher curricular complexity?

- The ***top tier schools had lower complexity ranges*** than middle and bottom tier schools in the programs of Electrical Engineering and Computer Science.
- Thus, ***curricular complexity is inversely related to program quality and student success***.





- ANOVA analysis verifies a statistical difference between the means of these EE populations.
- ANOVA analysis verifies a statistical difference between the means of these CS populations.

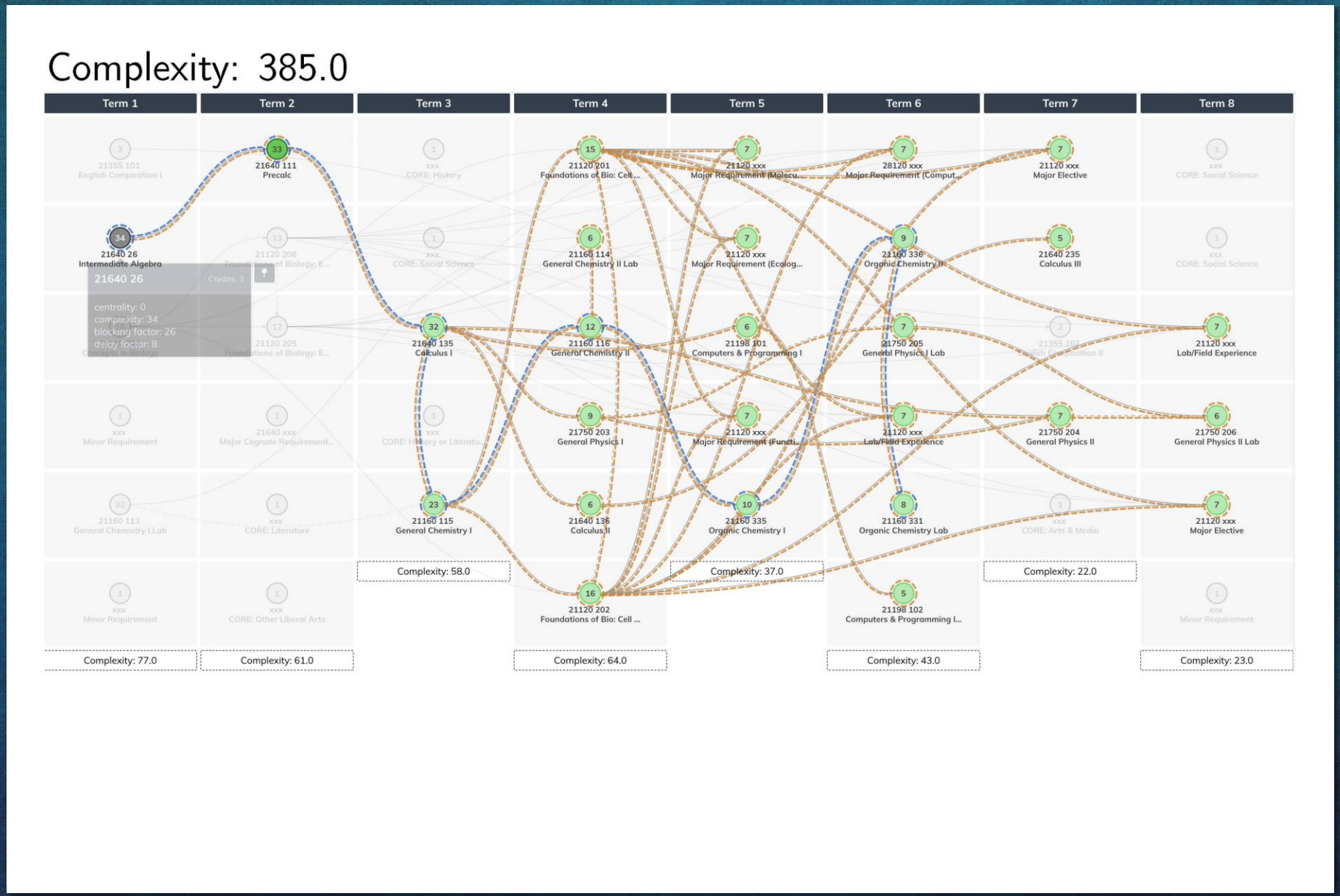
From Heileman (2020), a later work than the original 2018 paper.

- EE tiers defined by U.S. News & World Report – "Best Undergraduate Programs"
- CS tiers defined by CSRankings.org

Complexity ≠ Rigor

- High complexity ≠ high academic rigor
  - There is a clear difference between academic standards and artificial barriers to graduation.
- Typically, lower complexity = higher student success
- Rigor is unrelated to complexity

Live Demo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How to Use Curricular Analytics?

Curricular Comparisons

- Analyze the curricular inventory of USM for common curricular patterns, meta-majors, important courses, complexity outliers
- Compare/contrast the curricula across a discipline
- Compare a program's curricula to programs at peer institutions
- Relate curricular measures to other factors (e.g., complexity vs. quality, curricular equity)
- Relate a program's curriculum to other programmatic issues (e.g., change of major, success rates)

How to Use Curricular Analytics?

Curriculum Redesign

- Predict the impact of curricular redesigns.
- Compare/contrast potential curriculum to develop course sequencing (curricular design patterns).

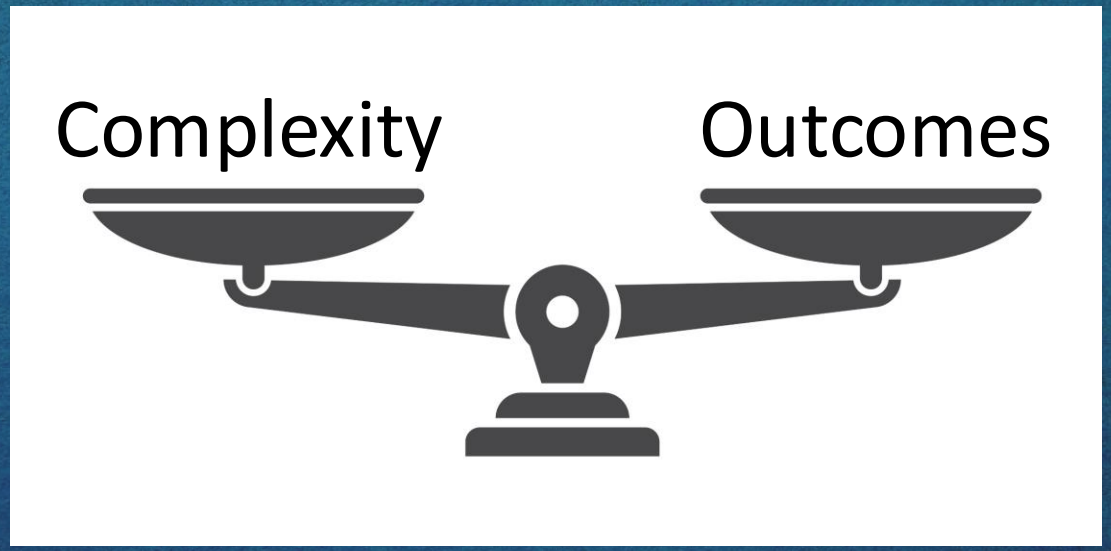
New Program Creation

- Compare similar curricula at other schools to better estimate a priori resource requirements (e.g., # new courses, # new faculty, # of students in classes).

Takeaways

Curricular Analytics is a tool.

It is not required to get degree plans to minimum complexity, rather this is a tool to compare and think deeper about complexity and curriculum decisions.



Takeaways

Possible Uses:

- **Assessment and continuous improvement**
  - Curricular Analytics data can be used as evidence in annual assessment reports
- **Targeted interventions**
  - Identify courses with high delay & blocking scores to compare against courses with highest DFW rates
  - Prioritize tutoring, supplemental instruction, or course redesigns for those with high complexity and high DFW
- **Modify advising practices**
  - Identify courses with high delay & blocking scores and inform advisors of those
  - Help explain to students the importance of these courses in staying on track
  - Plan “recovery” options (see if it is possible to DFW from one of these courses and still graduate on time. If not, is it possible to add/adjust course offerings to make recovery possible)

2025 – 2026 Degree Plans

- Current A.Y. Curricular Analytics visualizations will be ready for your review in the next few weeks
- School Directors & Program Coordinators will receive an email when these are published
- Once published, review & consider the implications. Let us know if you need help interpreting or if you find any errors in the visualizations.

Future Sessions

Deck the Data: Faculty Success Data Entry Workshop

December 16th

Assessment Report Requirements

Spring 2026

Questions?