Board 365: Reaching Consensus: Using Group Concept Mapping in a Multi-Site STEM Hub Research Team

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Reaching Consensus:

Using Group Concept Mapping in an S-STEM Research Team

Abstract

This study was done to explore Group Concept Mapping (GCM) as a method to reach consensus for data collection using document analysis in an S-STEM research team. The team was comprised of five members and the GCM approach was made up of six steps: (1) Preparation, (2) Generation, (3) Structuring, (4) Analysis, (5) Interpretation, and (6) Usage. The members of the team were asked to identify and rank any documents they thought could be useful as it pertained to each of the three research questions. Forty-five unique statements were generated and point plots and cluster shape charts were created for each research question to visualize which documents ranked highest for each one. After analyzing the data five key documents were identified to be useful for all three research questions. These five were: documentation regarding partner programs, transfer guides, websites on transfer at the four-year institution, shared agreements for sharing curriculum, and articulation agreements for the S-STEM program. This process proves to be useful for documentation identification and theming within data sets as it pertains to groups and team settings.

Introduction

The goal of this study to explore Group Concept Mapping (GCM) as a method to reach consensus for data collection using document analysis in an S-STEM research team located at an urban university in the Midwest. The team is comprised of five members all part of an S-STEM research team investigating how to help empower the transfer of low-income STEM students between two-year and four-year colleges. In addition, the research team is also part of a larger S-STEM Hub research team looking at transfer more broadly. During the first semesters of research on partnerships within the Hub it was clear there was a plethora of documentation that could be relevant to our studies. With a large team and an almost endless amount of data, it was quickly realized that a method to select relevant documents systematically and equitably was necessary, so GCM was called upon as a plausible method. As a pilot to the approach, we focused on the team at a single institution, and we plan to expand this approach to the Hub soon.

The GCM approach is made up of six primary steps: (1) Preparation, (2) Generation, (3) Structuring, (4) Analysis, (5) Interpretation, and (6) Usage (Group Concept Mapping). More specifically:

- Step 1, Preparation, the group project focus is defined. In our case, our defined focus was identification of documents deemed relevant. We defined ‘relevant’ as documents indicating presence/absence of a co-equitable partnership between institutions serving STEM transfer students.

- Step 2, Generation, the focus is reframed as prompts to spur brainstorming. To brainstorm all possible relevant documents, team members individually used the GCM software groupwisdomTM (https://groupwisdom.tech/). In all, forty-five relevant

documents were identified (e.g., transfer course equivalency lists, general education requirements, and regional accrediting agency requirements).

- Step 3, Structure, team members individually categorized the 45 documents in ways that made sense to them. As part of this step, they also rated each document by its perceived importance in responding to the project's central research questions.

- Step 4, Analysis, groupwisdomTM aggregates participant ratings into a concept map using multidimensional scaling. Ideas (i.e., documents) closer together on the map are those grouped together more frequently in the sorting. Hierarchical cluster analysis was used to identify clusters of ideas, or "themes." Finally, in this step, ratings were averaged for each idea and theme.

- Step 5, Interpretation, the resulting concept maps were interpreted by our team.

- Step 6, Usage, our team shall (in theory) use this systematically and equitably created list of documents upon which we will agree will best inform our project's goals.

While most of our team has had limited experience with GCM to reach group consensus, some of us are familiar with concept mapping. Participation in the study has been straightforward with all members of the team equally contributing to all parts of the project. Invitations were based on team members interest in being involved in the document identification and analysis side of the project.

The final goal of this study was to identify and shine light on the relevant documents which help to establish and promote co-equitable partnerships between two-year and four-year institutions.

Contextual Background

Concept mapping techniques were first developed by Joseph Novak in the 1970's while he was a researcher at Cornell University. He was researching children and found contextualizing and understanding their knowledge on science concepts through an interview transcription to be difficult. In a search for a more proficient method to understand this data he began to group and rate the data and thus the concept map was born. The goal of this concept map was to group and relate answers based on their relationships to each oher. This is done by using linking words or phrases between words or ideas and arranging them in a way that illustrates how everything is grouped [1].

During the 1980's and early 1990's William Trochim began to further develop concept mapping techniques and software at Cornell University. In 1982 he wrote the first version of The Concept System software [2]. The work of Trochim and his colleagues began to spread, and many others began using their techniques with most of the journal articles coming from medical fields, social sciences, and psychology. Over time various computer software programs have been developed to allow for a more expansive computerized mapping technique that promotes the opportunity for a more in depth look at the data. For example, CmapTools software is now free for download and utilizes a more expansive platform to organize and wade through large amounts of data vs just a tool to represent the data [3]. In this study the software used was Group Wisdom.

Despite the increase in the use of concept mapping there is limited research on the effects of concept mapping in education research and especially related to reaching group consensus. Much of the research that has been done has focused on the medical or healthcare fields looking at cognitive skills, collaboration, or critical thinking [4]. However, some studies have shown that exam scores and memory function are improved in students who use concept mapping techniques. These studies also imply that concept mapping techniques can lead to students becoming more interested and engaged in constructing positive interactions with the material leading to more "fun" while learning [5].

Little research has been done on utilizing concept mapping as the sole tool to reach group consensus. In a study done by Bergeron et al. concept mapping was used as one of the principles to help decide community-based design principles through group consensus for playground in Louisiana. The team appeared to have relatively good success with this approach and believe that each of the 25 community-based design principles supports the overall goal of the community-based design – that the "soul" of the community is co-created through the artifacts [3].

Methods

The current study is focused on document analysis by our research team for an S-STEM project in the Midwest. The goal of this study was to find what documents would be helpful to review before, during, and after our visits with both two-year and four-year institutions. All five members of the team were asked to submit their thoughts on the three research questions below. Participants were asked to provide as many documents as possible that applied to the focus questions and then the data was aggregated. The research questions were as follows:

- RQ1: In your opinion how useful are these types of documents/artifacts to increasing our understanding of the following: The characteristics of the partnerships between 2YR and 4YR colleges that support low-income STEM transfer student success and the individual partner sites.

- RQ2: In your opinion how useful are these types of documents/artifacts to increasing our understanding of the following: The effective strategies, programmatic activities, policies, and resources leveraged by the partnerships.

- RQ3: In your opinion how useful are these types of documents/artifacts to increasing our understanding of the following: The ways partnership capital, cultural wealth, and the individual institutional context of equity shape the development and sustainability of co-equitable partnerships.

The project was subdivided into a few different stages. This included brainstorming, rating, sorting, and analyzing the data. The first stage of the project was the brainstorming section. This was comprised of the five team members providing as many statements as possible that could apply to the three research questions. Then statements were then analyzed and any like statements were removed. This left a unique list of 45 statements which can be viewed in the Results and Discussion section below. Once the list was consolidated the next step was to rate each of the statements on its usefulness on a scale of one of five as it pertains to each research question. The final step of the process was to sort each of the 45 statements into categories for

each research question. All these charts can be viewed below in the Results and Discussion section.

Study Results and Discussion

Below is the 45 unique statements which were produced collectively by our five research team members. The original list was larger, but duplicates were removed. Each statement is numbered, and this corresponds to the number on the point and cluster charts below, for each of the research questions.

Table 1: Statements generated to determine potentially useful documents to answer RQ1, RQ2 and RQ3

Statement Number	Statement	Statement Number	Statement
1	Photographic documentation from site visits	24	Veteran support documents
2	Documentation of COVID context at institution	25	Financial aid and scholarships available to STEM transfer students at four-year institutions
3	S-STEM Proposal Reviewers comments	26	Financial aid and scholarships available to two-year STEM students
4	S-STEM Proposal	27	Tuition and fees documents, including any tuition reciprocity agreements
5	Advising resources	28	Academic program overviews
6	Mentorship resources	29	Documentation of any state/local supported programs & policies for such programs
7	Documentation regarding partner programs	30	Recognitions/honors/awards for transfer services
8	Documentation of unofficial degree audits	31	Social media accounts that target two-year students related to STEM degrees
9	Documentation on available academic tutoring/coaching	32	Social media accounts that target four-year students related to STEM degrees.
10	Documentation of recent alumni	33	Websites on transfer at four-year institutions.
11	Documentation regarding academic programs	34	Websites on transfer at two-year institutions
12	Documentation describing possible career pathways	35	Any shared agreements for sharing curriculum.

13	Admission requirements	36	Articulation agreement for the S-STEM program.
14	Institutional documentation of implementation of state laws/policies regarding transfer	37	Transfer Course Equivalency List
15	Commuter/parking maps	38	Transfer Credit Report
16	Major maps	39	3rd party transfer software e.g., Transferology (external course equivalency database https://www.transferology.com/index.htm)
17	Transfer guides	40	Documentation on Transfer Credit Coordinator/s
18	General Education requirements	41	Course Catalog
19	Mission and Vision statements of Higher Education Institutions	42	State-level transfer and articulation policies: https://www.ecs.org/50-state-comparison-transfer-and-articulation/
20	State Tuition Program initiatives	43	Major maps
21	Documentation of system level transfer policy/course list	44	Plan for degree program completion at receiving institution
22	Documentation of accreditation agency and process	45	Degree audits
23	Experiential credit documents		

The point plots below shown in Figures 1, 2, and 3 are based on a rating scale of one to five. The score with a higher value is one that indicates that this statement/document was viewed as more helpful and/or useful. A score of one indicates that the statement/document was of little value when rated by the research team. The software averaged the scores across all five researchers to provide an average score for each statement which is represented by an arrow above the dot. The more arrows, the closer the averaged value was to five.

The cluster shape charts shown below in Figures 4, 5, and 6 are representative of the sorting and rating activities combined. There were seven categories that the documents could be sorted into: Institution-Level Stuff, S-Stem Proposal, Financial Aid, Stuff Related to Courses/Curriculum, Academic Advising, Resources for Transfer Students, and Student Recruitment. The size of the shape indicates the closeness of the statements averaged across the five team members. This means a large shape indicates that this group of statements was not uniform across the five researchers. This would indicate that each researcher grouped the statement differently. A small shape would mean the opposite, and would indicate that the majority of the researchers grouped

these statements into the same category. The second piece to these charts is the depth of the chart itself. This represents the rating of each of those statements included in the group averaged for each researcher and then averaged again for each of the five researchers to provide a single score for each category. The higher the number the more layers or depth the chart shows and the lower the score, the less depth or layers the chart shows.

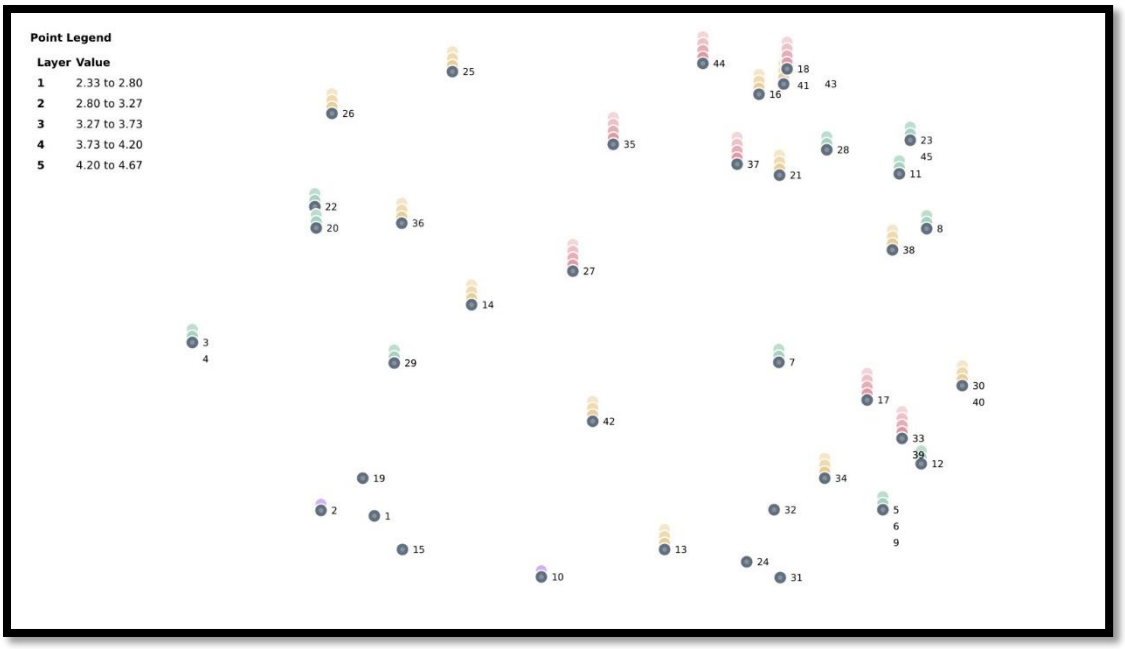

Figure 1: RQ1 point map displaying the statement and their rating scores out of five.

The above point plot of the RQ1 indicates that there is a relatively high number of useful documents that would help low-income STEM transfer students between two-year and four-year institutions. These statement numbers with the highest rating are 17, 18, 27, 33, 35, 37, and 44. These are not necessarily close on the graph which indicates they were grouped into different categories during the sorting activity.

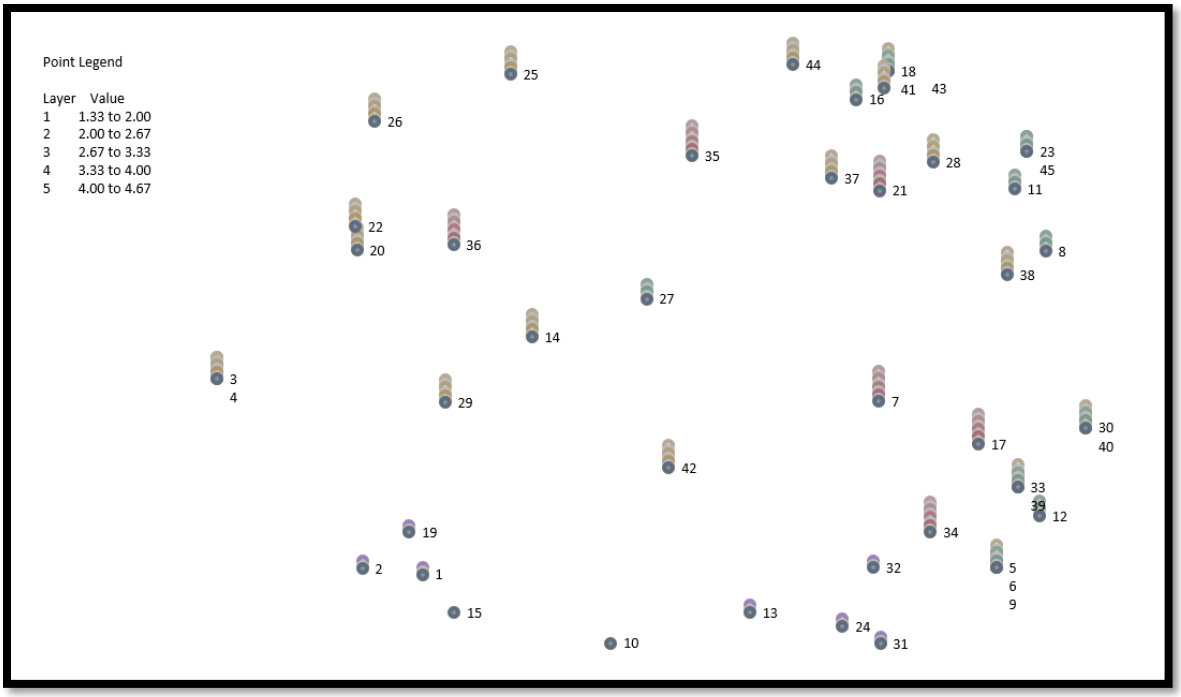

Figure 2: RQ2 point map displaying the statements and their rating scores out of five.

Figure 2 shows again a high number of statements that would be helpful for understanding the effective strategies, programmatic activities, policies, and resources leveraged by the partnership between two-year and four-year institutions. These again are relatively spread apart but the majority of the highest scoring statements occur in the top portion of the chart. The statement numbers that score the highest appear to be 7, 17, 21, 34, 35, and 36. But it should also be noted there is a high number of mid-level ratings and a large number of low-level rating (a score of one).

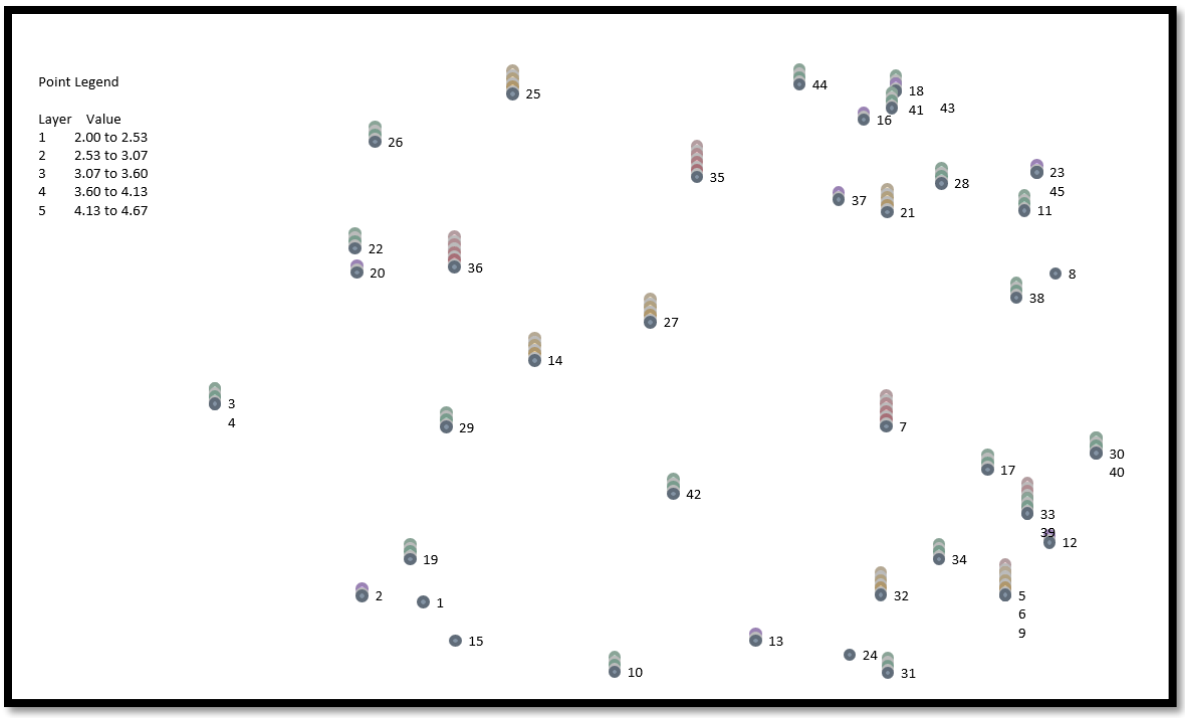

Figure 3: RQ3 point map displaying the statements and their rating scores out of five.

Figure 3 seems to display the lowest number of high rating statements. This would indicate that this research question on the ways partnership capital, cultural wealth, and the individual institutional context of equity shape the development and sustainability of co-equitable partnerships is more difficult to answer with this document list. However, there are still some high scoring statement numbers which appear to be 5, 7, 33, 35, and 36. This plot also appears to have many low scoring statements between the values of one and two.

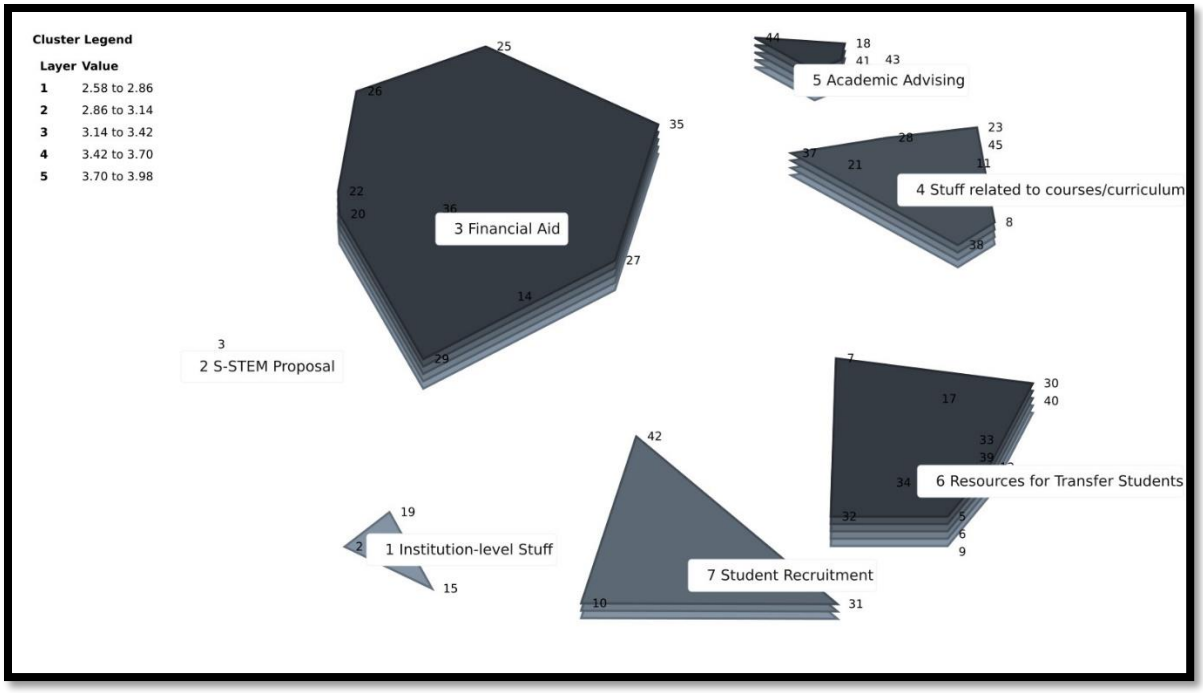

Figure 4: RQ1 cluster map displaying how the different statements were grouped based on the team sorting activity.

Figure 4 shows us that the "Financial Aid" and "Resources for Transfer Students" are the highest rated categories for answering RQ1 followed closely by "Stuff Related to Courses/Curriculum". These shapes are all relatively big which indicates that not everyone grouped these statements the same way, but they were all viewed as valuable based on their rating. Institutional-Level Stuff appears to be the tightest grouped category but the least useful.

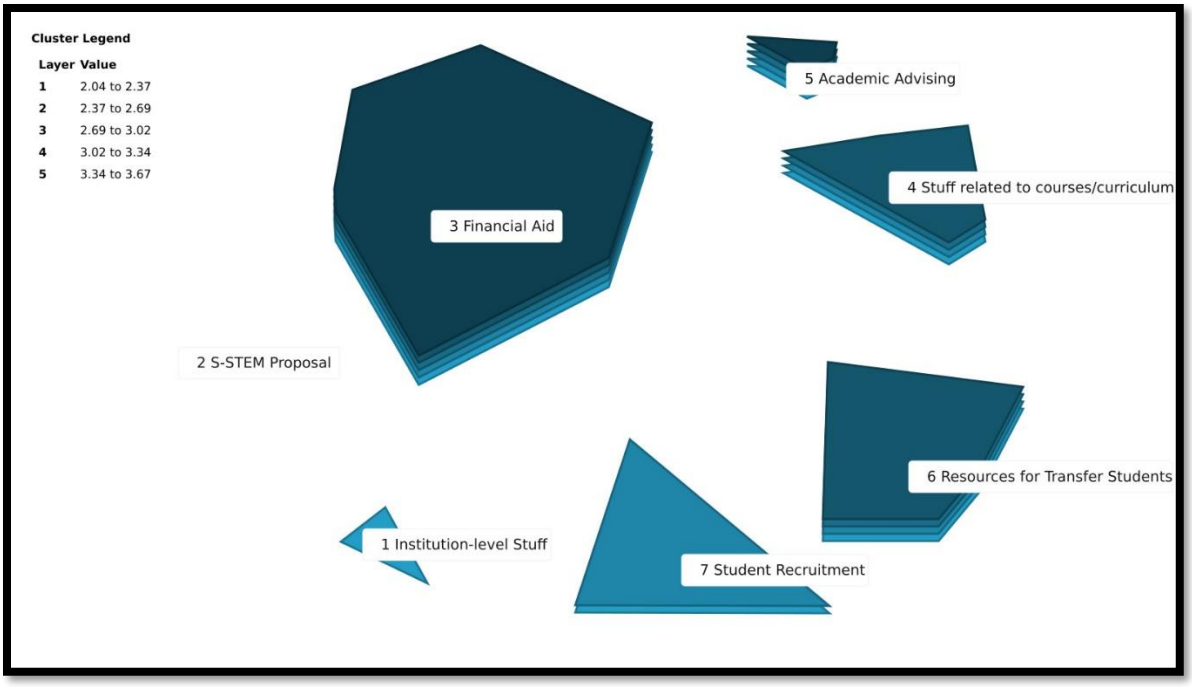

Figure 5: RQ2 cluster map displaying how the different statements were grouped based on the team sorting activity.

Figure 5 tells us that “Financial Aid” and “Academic Advising” are the most important category based on rating for answering RQ2. The size of “Academic Advising” also tells us that the research team mostly agreed on the rating and sorting of this category. The next most important categories were “Stuff Related to Courses/Curriculum” and “Resources for Transfer Students”. Which again tell us that these categories are helpful for answering RQ2.

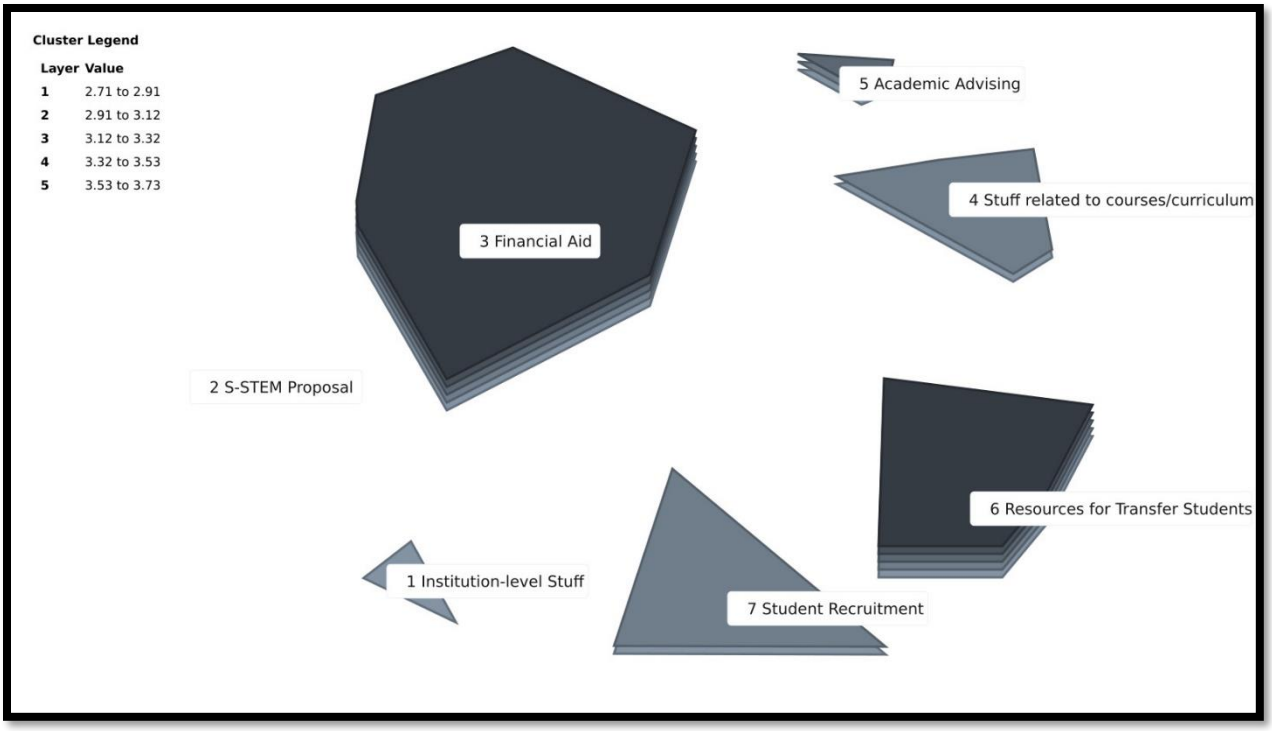

Figure 6: RQ3 cluster map displaying how the different statements were grouped based on the team sorting activity.

Figure 6 shows us that to answer RQ3 we need to again look at “Financial Aid” and “Resources for Transfer Students” documents. These were the highest rated document categories with a score much higher than any of the other categories. The next most relevant category was “Academic Advising” with three layers compared to “Financial Aid” and “Resources for Transfer Students” which both had five layers indicating they are the dominate document sources for answering RQ3.

After looking through the points charts for all three research questions a few statements/documents in particular jump out that seem to be highlighted as being consistently rated higher by all researchers for multiple or all of the research questions. These statements are as follows:

- 7, documentation regarding partner programs
- 17, transfer guides
- 33, websites on transfer at the four-year institution
- 35, any shared agreements for sharing curriculum
- 36, articulation agreements for the S-STEM program

While some of these are relatively open ended in their description this gives a good starting point on where and what type of documentation to look for as a base starting point. From here the research team can begin their search and then expand or refine as they see fit. The next best step in the process would be to look more in depth at those documents that appear with three arrows and see which ones appear most often and so on and so forth for those with two, and one arrow.

This would be a good approach before even collecting any documents as it could help refine the search to more useful documents from the very beginning.

Conclusions and Further Work

The data obtained independently from the five members of the research team were used to generate point maps and cluster maps using multi-dimensional scaling that were useful in discussions of the most useful documents to collect and to themes within data collection. We are currently incorporating this into our planning processes. We expect to complete reflections on this process soon.

References

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