Comparing Two Human-Computer Interactive Textual Analysis to Identify Evidence for Policymaking: Analyzing Interview Data for Advancing Educational Equity

Abstract. Obtaining stakeholders' diverse experiences and opinions about current policy on a timely manner at scale is crucial for policymakers to identify assets and gaps in resource allocations to support policy design and implementation. However, manually coding even a moderate amount of interview texts or open-ended survey data from stakeholders can often be labor intensive and time costly. Although automated text analysis has promise to reduce these costs, policymakers may be less inclined to completely rely on an automated approach that is not based on disciplinary theories and policy contexts. Integrating human experts' inputs into automatic textual analysis may mediate policymakers' concerns. In this study, we compare two human-computer interactive learning approaches to analyze stakeholders' interviews about policies that advance racial and economic equity in K-12 public schools in one U.S. state. With *computer-human parallel* analysis, human coding guided by a domain-specific theoretical framework happens in parallel with unsupervised topic modeling. In the second *computer-human sequential approach*, unsupervised topic modeling occurs first and then human coders use the initial theme discovery to develop a codebook and then code the interview data. While each approach offers nuances and allows human experts to use their domain knowledge to validate, interpret, and supplement the computer analysis results, the *computer-human sequential* approach offers a better integration of the advantages of both computer and human coding to enable a faster evidence generation to support policy decision making in this study.

1   Online Appendix

1.1   A1. Interview Protocol (45 minutes)

Background Questions (5 mins).

1. Could you please briefly describe your role, your primary responsibilities, and how long you have been in your current role?
2. How do you define racial and economic equity in education? What are the specific equity-related goals you/your organization are striving to achieve?

Current Policies (15 mins). [We will need to do some background study of interviewee's work before the interview]

3. From your work and based on your perspective, can you offer 1 or 2 examples of current state and/or local policies that you think most ***enhance*** racial and economic equity in the Washington State public education system?

[Probe] Why and how do you think this policy/strategy has enhanced racial and economic equity?
[If you sense the interviewees have expertise to comment on any of the following, please probe:]

   a. (3.1) In terms of school finance, can you think of ways that state and local policies enhance racial and economic equity?
   b. (3.2) In terms of school governance, can you think of ways that state and local decision-making structures and processes enhance equity?
   c. (3.3). In terms of teacher resources, can you think of ways that current policies promote racial and economic equity?

4. From your work and based on your perspective, can you offer 1 or 2 examples of current state and/or local policies that you think most ***limit*** racial and economic equity in the Washington State public education system?

[Probe] **Why and how** do you think this policy/strategy has limited racial and economic equity?
[If you sense the interviewees have expertise to comment on any of the following, please probe:]

   a. (4.1) In terms of school finance, what factors hinder the equitable distribution of resources across groups of students based on race and income? How could the state more equitably distribute resources across geographically regions?
   b. (4.2) In terms of school governance, how do current policies or processes hinder collaboration to promoting equity?

      o The relationship between the teacher union and school district is also critical for school governance. Could you also comment on how to build a better relationship between these two parties?

   c. (4.3). In terms of teacher resources, do you experience teacher shortage? in what aspects (e.g., ELL, special edu, STEM)?

      o What are the major barriers for recruiting and retaining effective teachers, particularly teachers of color?

5. We know that COVID-19 has brought devastation to many communities. But we also know that changes of this magnitude present opportunities. Are there any opportunities to advance racial and economic equity that you see as we "build back" from COVID-19?

Information Gaps (15 mins). [This next set of questions focuses on current information gaps in the state.]

6. In the context of your work, do you feel that you have access to reliable information or data that you need to effectively do your job?

   [if yes]

   — Which resource/s do you consult most frequently?
   — What do you find most helpful about that resource/those resources?

   [if no]

   — What kind of information could better support policy development/implementation?

   [if you sense the interviewees have expertise to comment on any of the following, please probe:]

   a. (6.1) Are there specific knowledge gaps around *school finance* that are limiting actions that can advance racial and economic equity?
   b. (6.2) Are there specific knowledge gaps around *school governance* that are limiting actions that can advance racial and economic equity?
   c. (6.3) Are there specific knowledge gaps around *teacher distribution/shortages* that are limiting actions that can advance racial and economic equity?

Potential Improvements (15 mins).

7. In the context of your work, can you think of any specific information, data or tools that could help you make better informed decisions?

[probe] in your view, who in the state is in the best position to take lead in generating and distributing that information/data or developing that tool?

1.2   A2. Rubrics and Procedures for Rating Topic Coherence

Step 1: Preparation. Using the STM visualization graph, select at least 20 tasks that have the highest proportion loaded on one given topic. Start with the highest proportional ones, then read through the statement of tasks, synthesize key ideas across the tasks, and label each topic.

Step 2: Use the last column in the attached template in the spreadsheet to record your summary (or 2–3 key words) of the exemplary document you are reading. This helps you to clearly apply the rubrics below and keep track of documents you have reviewed.

Step 3: Rate topic coherence using the following metrics for the extent to which the topic is coherent.

On a 4-point scale: 4 = a great deal; 3 = moderate; 2 = little; 1 = none

- 4 = *a great deal*: It is easy for me to find one coherent latent construct for this topic. The label emerges from the exemplary documents coherently.

- 3 = *moderate*: The topic contains 2–3 latent constructs; however, they are closely related. I am still able to come up with one label to summarize almost all exemplary documents.

- 2 = *little*: The topic contains more than 2 latent constructs that are somewhat connected. I manage to come up a label, but it only summarizes a portion of the exemplary texts well.

- 1 = *none*: The documents under this topic are largely random, with no clear relationships.

Step 4: Record your rationales for (a) the label you have created; and (b) the topic coherence rating you have given.

1.3 A3. Computer-Human Parallel Text Similarities.

Topic #	Parent Code	Child Topic Code	Topic Label	Expert Coherence Rating	Human Parent Code	Human Child Code	Cosine Similarity
1			(low coherence)	1			
2	leadership and governance	leadership and governance	relationships between state and local public school systems (decentralization and local control) and relationships between public school systems with non-profit organizations	3.5	leadership, governance and structures	governance structures	0.5527
3	leadership and governance	local control or school board	school boards' role in decision making (particularly, budgeting) under local control and relevant stakeholders	4	leadership, governance and structures	school board	0.6129
4	student interventions	social-emotional learning (sel) and mental health	resources supporting youth's sel and mental health	4	student interventions strategies	behavioral mental health	0.4953
5			(low coherence)	1			
6	system interventions	school system support	tier support system and school improvement	4	student interventions strategies	testing	0.7272
7	system interventions	judicial systems	court, judicial systems, and institution's role in racial equity	4	social climate	gender and sexual identity	0.4618
8	school finance	funding formula	funding formula based on districts' needs, local levies, and allocations of mccleary and stimulus funds	4	education finance	funding formulas	0.7782
9	leadership and governance	coalition and relationship	going beyond superficial things (counting and disaggregating numbers) and building relationships and coalition centering the voices of youth and famiies in marganized communities	3	data, measurement and information (DMI)	information networks	0.5279
10	staffing policy	teacher union, salary, workforce	teacher union's politics, local collective bargaining processes, and union influences on teacher salaries and hiring	4	education system climate	union dynamics	0.7695
11	data and information	data access, analysis, use	data collection, access, analysis and use	4	data, measurement and information (DMI)	data access	0.8028
12			(low coherence)	2			
13	instruction and curriculum	teaching and learning	teaching and learning (online and hybrid), teacher training, curriculum, student experience	3	staffing resources	teachers training support	0.6460
14	culture, climate and environment	racism	whiteness, barriers for children's success, and racism	3	social climate	racism	0.6819
15			(low coherence)	1.5			
16	staffing policy	teacher mentoring and coaching	new teachers' coaching, mentoring, and professional development in equitable instruction and curriculum (adopt, professional-learn)	4	staffing resources	teachers training support	0.7575
17	leadership and governance	school board	school board diversity and representation, accountability system, and inquiry cycles	4	leadership, governance and structures	leadership capacity	0.5383
18	school finance	targeted funds	targeted funds for specific activities/programs: funds available for other purposes than teacher salary, funding for teacher prep, and targeted investment in community of color	3	staffing resources	teacher labor market	0.5436
19	data and information	goals and oucomes	education and school improvement goals, school courses, educational outcomes, and jobs	3.5	student interventions strategies	post-secondary transition	0.6630
20	leadership and governance	community	building school system's capacity to engage with communities	4	leadership, governance and structures	community level strategies	0.6109
21	student interventions	differentiated student strategies	differential and targeted strategies for students of color, particularly american african, southeast asian, hispanic	4	data, measurement and information (DMI)	sources of information	0.6457
22	student interventions	multilingual programs	access and quality of bilingual, multilingual programs offered to english lanaguage learners	4	student interventions strategies	culturally inclusive	0.6741
23	culture, climate and environment	trauma at home	struggling home and family experiences of children of high poverty and of color negatively influence their school learning and graduation pathways post pandemic	4	social climate	covid and public health	0.6794
24	staffing policy	diversifying teacher workforce (teacher labor market)	teacher education, diversifying teacher candidate pool/ pathways, and partnerships between k-12 and higher edu, and with outside organizations	3	leadership, governance and structures	community level strategies	0.5485
25	school finance	progressive funding	special education, federal and state funding for districts with low-income, ell, special-ed, and multicultural students who need more supports	4	education finance	funding formulas	0.6783
26	data and information	tests, standards, measures, and graduation requirements	tests, standards, graduation requirements, college readiness, and measure and data disaggregation by race and ethnicity	3.5	student interventions strategies	testing	0.5806
27	student interventions	learning opportunities and programs	learning opportunities in schools, and tribal and native education	3	student interventions strategies	curriculum and instruction	0.6236
28	leadership and governance	leadership diversity	leaderhsip, diverse community, and leadership in diversity	3	leadership, governance and structures	community level strategies	0.5738
29			(low coherence)	2			
30	governance and leadership	legislation process	bills and legislation process	3.5	social climate	housing and geography	0.4707