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Planning Effective Instructional Interventions

Abstract

While instructional intervention studies predominately focus on empirically evaluating interventional outcomes, the question of where an intervention should take place is often neglected. To bridge this gap, this paper integrates a learners' perspective into planning effective interventions, using group concept mapping. Employing this approach enables higher education institutions to prioritize where to intervene and, hence, to direct their planning efforts to areas in which most impact can potentially be made on attaining intended learning outcomes.

Keywords

educational effectiveness, instructional intervention, group concept mapping

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1 Introduction

Higher education institutions (HEI) striving for continually improving their quality of teaching and learning, eventually implement instructional interventions. Evaluating such interventions, instructional effectiveness research predominately focuses on whether interventions work. "What works," MUIJS (2008) states is what really matters, meaning that learners should be able to demonstrate better attainment of intended learning outcomes because of an intervention.

Instructional effectiveness research, however, falls rather short on guiding "where" an intervention should take place. The "where," however, is also important as many HEI need to put their scarce resources to work where they can possibly impact on learning the most. Hence, HEI need to plan and implement instructional interventions where the attainment of intended learning outcomes can maximally be affected.

To bridge the gap in instructional effectiveness research, this paper puts forward how group concept mapping (TROCHIM, 1989; TROCHIM & KANE, 2007) can be used to decide "where" HEI should consider instructional interventions.

2 Background

2.1 Planning effective instructional interventions

When learners lack the ability to demonstrate attainment of intended learning outcomes, instructional interventions are often implemented at the classroom level (for multiple levels in educational systems cf. CREEMERS & KYRIAKIDES, 2006; SCHEERENS, 2015) as a primary level in educational effectiveness research (cf., CREEMERS, 1994; MUIJS, 2008).

Instructional interventions are considered effective when learners achieve higher goal attainments. Consequently, studies measuring an intervention's effectiveness routinely report on effectiveness by means of pre-/post-comparison in attaining intended learning outcomes. For example, in an intervention study on integrating systems thinking into geography education, COX, ELEN, and STEEGEN (2019) measured effectiveness through a quasi-experimental design. Using pre- and post-tests as well as exam questions, they demonstrated that the treatment group outperformed the control group, proving that the intervention had a significant positive effect. In another study (COX, ELEN, & STEEGEN, 2020), the same researchers used think-aloud interviews to collect qualitative data in a smaller-scale intervention study on causal diagrams. Analyzing the differences between two groups allowed them both to explain how learners attained disciplinary knowledge and to assess whether the intervention was effective.

Although considerable research has been devoted to evaluating whether learners realize higher goal attainments, less attention has been paid to “where” interventions should take place. Educational effectiveness research focusing on testing results provide a rather coarse indication for “where” an intervention might be needed, because formal testing often captures a subset of concepts. To understand where learners struggle exactly, a much finer-grained view is needed. Such a view can be obtained, for example, by including the perspective of learners, who usually show good awareness of their own abilities and any gaps in attaining indented learning outcomes (ANAYA, 1999; BENBUNAN-FICH, 2010).

2.2 Group concept mapping

One way to integrate the learners’ perspective into planning effective instructional interventions is through group concept mapping (GCM). GCM (TROCHIM, 1989; TROCHIM & KANE, 2007) is a participatory research method that integrates qualitative group processes with multivariate statistical analyses that can be used to structure and visualize content of a specific topic (ROSAS, 2017).

Originally employed in public health, social work, health care, and mental health care research, GCM has successfully been put to use in higher education research, including studies on, for example, student well-being and stress (DONOHOE, O’ROURKE, HAMMOND, STOYANOV, & O’TUATHAIGH, 2020) or helping college students with their nutrition (COUSINEAU, FRANKO, CICCAZZO, GOLDSTEIN, & ROSENTHAL, 2006).

GCM has also been used in examining student learning and curriculum development, such as designing educational videos (SHOUFAN, 2019) and effective (online) learning environments (KILTY et al., 2017; SCHOPHUIZEN, KREIJNS, STOYANOV, & KALZ, 2018); identifying challenges in learning a particular skill (SHEN, TAN, & SIAU, 2018); or developing learning outcomes and curriculum (HYNES ET AL., 2015; STOYANOV et al., 2014). This suggests that GCM may well be a promising approach to integrating the learners' perspective to pinpoint where instructional interventions are needed.

2.3 Objectives

The main objective of this paper is to illustrate and discuss how GCM can be used to integrate the learner's perspective into planning effective instructional interventions.

3 Research design

To illustrate and discuss how GCM can be used to integrate the learner's perspective into planning effective instructional interventions, the research examined a project management course where interventions might be needed. The course was taught in the last year of a 4-year program at a Canadian university, leading to a bachelor's degree in business administration. Sixteen out of 20 students participated voluntarily in the research project.

The six GCM stages established by TROCHIM & KANE (2007)—i.e., project preparation, idea generation, idea structuring, map computing, map interpretation, and map utilization—were followed with one modification to the idea generation stage.

During the idea generation stage, students were not directly involved. Instead, the textbook (MEREDITH, SHAFER, MANTEL, & SUTTON, 2017) was consulted to generate statements that aligned with both the course's intended learning outcomes and syllabus. Based on the focus prompt: "Upon completion of this course you are able to …," the author originally identified 93 statements. These were further validated by a colleague for consistency and overlaps, resulting in a comprehensive list of 75 statements in total.

Idea structuring took place in the second-last class of the semester. First, students were instructed to sort all statements in piles based on how similar in meaning they were to one another. Second, students were asked to rate the statements on a four-point Likert scale according to *importance* and their self-assessed *ability*. Importance was rated as: 1 = relatively unimportant, 2 = slightly important, 3 = moderately important, and 4 = very/extremely important. Ability to demonstrate the skills was rated as: 1 = I am not able to demonstrate this, 2 = I am somewhat able to demonstrate this, 3 = I am moderately able to demonstrate this, and 4 = I am very able to demonstrate this.

Student responses were computed to generate point, cluster, pattern match, and go-zone maps, using the web-based GroupWisdom platform (CONCEPT SYSTEMS, 2020). Students were invited to participate in the interpretation of these maps in the last class of the semester.

4 Results

4.1 Relationship between statements

Figure 1 visualizes the participants' sort data in form of a point map, appreciating the relationship between the 75 statements. Applying multidimensional scaling to the sort data, the point map two-dimensionally depicts how participants sorted the statements. The closer statements appear to each other as points on the map, the more often they were put in a pile with one another. Thus, the map indicates how close the statements were in meaning from the learners' perspectives.

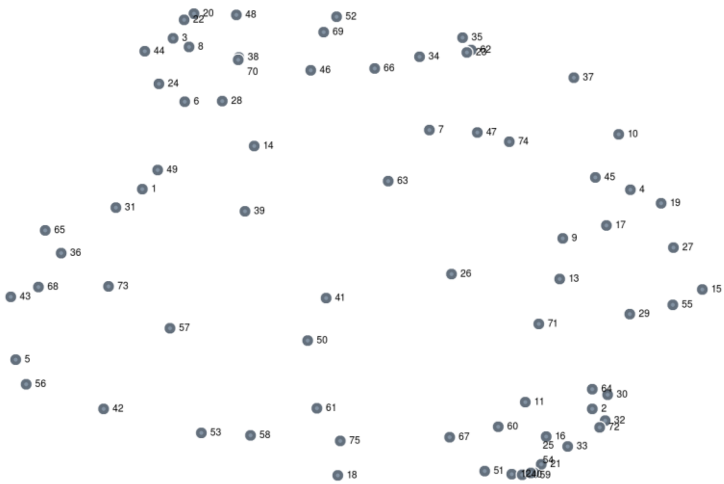

Figure 1: Point map

The point map's stress value is 0.2661 after 19 iterations. In GCM projects stress values typical range between about 0.205 and 0.365 (TROCHIM & KANE, 2007), suggesting that the map constitutes a good representation of the participants' sorting.

4.2 Categories of statements

Based on the point map, hierarchical cluster analysis was applied to group individual statements into categories. This resulted in seven clusters of statements that are similar in meaning: *Projects*, *Project manager*, *Success*, *Risk management and planning*, *Scheduling*, *Budgeting*, and *Evaluating and closing*.

Figure 2 visualizes the clusters and Table 1 provides an overview of the clusters' statement count, average bridging values, standard deviations, and ranges. The lower a cluster's mean bridging value, the more frequently participants grouped statements in this cluster together. Higher bridging values imply that several statements were frequently sorted with those in other clusters.

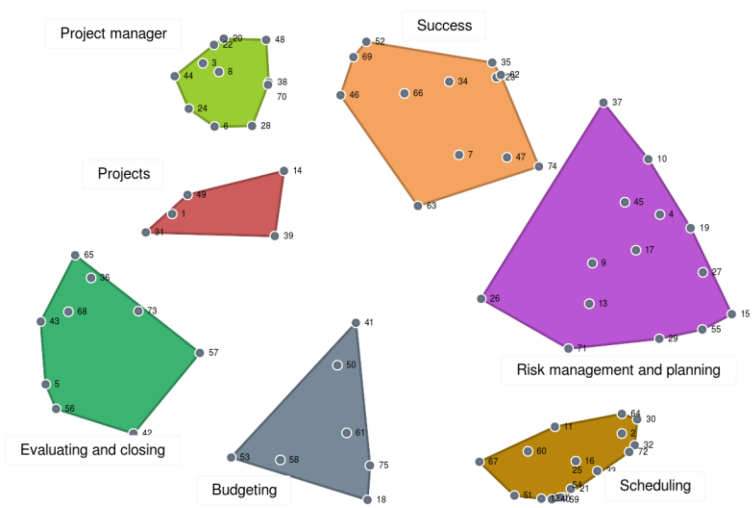

Figure 2: Cluster map

The clusters with the lowest average bridging values and thus most coherence are *Scheduling* (0.12) and *Project manager* (0.37). Moderately coherent clusters are *Projects* (0.53), *Risk management and planning* (0.54), and *Success* (0.55). The clusters with the highest bridging values and, thus, least coherent are *Evaluating and closing* (0.71) and *Budgeting* (0.77).

A brief description of each cluster follows to comprehend the labelling and content.

Table 1: Description of the seven clusters

Cluster	Statement count	Bridging value		
		Mean	Std. Dev.	Range
Projects	5	0.53	0.07	0.46–0.67
Project manager	11	0.37	0.08	0.28–0.51
Success	12	0.55	0.07	0.43–0.68
Risk management and planning	14	0.54	0.08	0.44–0.71
Scheduling	17	0.12	0.10	0.00–0.37
Budgeting	7	0.77	0.11	0.66–1.00
Evaluating and closing	9	0.71	0.11	0.58–0.88

4.2.1 Projects

Projects is one of the moderately coherent clusters, containing five statements (Table 2), mostly concerning the nature of projects. The cluster's bridging values range from 0.46 to 0.67 (*M* = 0.53, *SD* = 0.07), implying that participants frequently placed the statements in piles relating to other clusters. Some central ideas such as, a project's life cycle, triple constraints, or benefits management realization are still well located within this cluster.

Table 2: Projects cluster

Statement		Bridging
1	explain the "iron triangle" or triple constraints of a project	0.51
14	explain the project life cycle	0.47
31	explain the role of quasi-projects	0.54
39	describe the Program Evaluation and Review Technique (PERT)	0.67
49	explain the concept of benefit realization management	0.49

4.2.2 Project manager

Project manager is a more coherent cluster, confirmed by the bridging values ranging from 0.28 to 0.51 (*M* = 0.37, *SD* = 0.08). The eleven statements (Table 3) in this cluster focus predominantly on the project manager's traits such as being able to resolve conflicts, communicate effectively, or performing effective team meeting, as well as emotional intelligence, negotiation skills, and so on. The cluster's comparatively low mean bridging value confirms that the participants had a fairly common understanding of the demands placed on a project manager.

Table 3: Project manager cluster

Statement		Bridging
3	perform effective project team meetings	0.33
6	maintain a stakeholder register	0.51
8	describe emotional intelligence (EQ)	0.28
20	resolve conflicts	0.29
22	apply an ethical perspective to project management	0.36
24	identify stakeholder and to analyze their needs	0.49
28	describe the concept of the project owner	0.33
38	define the role and responsibilities of the project manager	0.31
44	negotiate win-win outcomes	0.40
48	communicate effectively as project manager	0.29
70	conduct an effective project launch meeting	0.47

4.2.3 Success

Success is another moderately coherent cluster, containing twelve statements (Table 4). Bridging values range from 0.43 to 0.68 (*M* = 0.55, *SD* = 0.07). While some statements are related to success, others clearly span into adjacent clusters. For example, the statement selecting a project manager was often sorted with statements in the *project manager* cluster, or applying brainstorming techniques was often sorted with mind-mapping techniques in the *risk management and planning* cluster. This confirms that the cluster is rather inconsistent, including statements that are closely related to neighboring clusters.

Table 4: Success cluster

Statement		Bridging
7	list measures for project progress	0.61
23	list criteria for project failure and project success	0.60
34	contrast agile project management with the traditional waterfall approach	0.60
35	list criteria for project success	0.54
46	describe different forms of project organization	0.46
47	develop a project charter	0.60
52	list characteristics of effective project teams	0.43
62	apply brainstorming techniques	0.56
63	recognize the “sacred cow” selection method	0.58
66	compare virtual to traditional projects	0.50
69	select a project manager for a particular project	0.46
74	define milestones in a project	0.68

4.2.4 Risk management and planning

Risk management and planning is a moderately coherent cluster too. The bridging values for this cluster with 14 statements (Table 5) range from 0.44 to 0.71 (M = 0.54, SD = 0.08). Also, in this cluster some statements are located at the edges to neighboring clusters. Particularly more planning-related statements around identifying the critical path in a network or estimating the time to complete activities show strong bridging into the *Scheduling* cluster, indicating the interconnectedness of these statements.

Table 5: Risk management and planning cluster

Statement		Bridging
4	create a RACI Matrix	0.52
9	conduct a Failure Mode and Effect Analysis (FMEA)	0.55
10	develop a contingency plan	0.71
13	perform a risk analysis for a project	0.51
15	construct an activity-on-node network	0.45
17	identify predecessors and successors to activities	0.62
19	construct a work breakdown structure (WBS)	0.47
26	use numeric and non-numeric methods for selecting a project	0.58
27	construct a Gantt chart	0.49
29	identify the critical path in a network	0.47
37	use mind mapping techniques	0.68
45	break down projects into activities	0.58
55	construct an activity-on-arrow network	0.44
71	estimate the time to complete activities	0.45

4.2.5 Scheduling

Scheduling contains 17 statements (Table 6). It is the most coherent cluster in the map with bridging values ranging from 0.00 to 0.37 (M = 0.12, SD = 0.10). This implies that most participants shared a common view on how the statements relate to one another. Many statements are linked to calculative abilities such as, calculating slack, earliest start/finish time, and so on.

Table 6: Scheduling cluster

Statement		Bridging
2	calculate slack	0.15
11	evaluate unweighted and weighted factor methods for scoring projects	0.25
12	calculate the Net Present Value (NPV) of a project	0.05
16	choose which activities to crash and by how much to achieve the minimum cost for all possible project completion times	0.15
21	calculate the cost performance index (CPI)	0.04
25	calculate earned value	0.00
30	calculate probabilistic activity times	0.17
32	calculate earliest start (finish) time (ES, EF) and latest start (finish) time (LS, LF)	0.10
33	calculate critical ratios	0.07
40	calculate estimated (cost) at completion (EAC), budget at completion (BAC), and estimated (cost) to complete (ETC)	0.03
51	calculate the payback period for a project	0.16
54	calculate the actual cost of work performed (AC)	0.00
59	calculate the cost (spending) and schedule variances	0.01
60	calculate the learning curve for recurring tasks	0.23
64	calculate Risk Priority Numbers (RPN)	0.22
67	demonstrate how a hurdle rate of return is used when selecting amongst projects	0.37
72	calculate the probability of path (project) completion	0.09

4.2.6 Budgeting

Budgeting is the least coherent cluster, containing seven statements (Table 7). The cluster shows bridging values ranging from 0.66 to 1.00 (M = 0.77, SD = 0.11), indicating that it is a rather diverse cluster where the participants did not frequently place this cluster's ideas together. Yet there is a common theme. Many statements in this cluster deal with budget-related issues, some of which were frequently sorted together with statements from the *Scheduling* and *Evaluating and closing* clusters.

Table 7: Budgeting cluster

Statement		Bridging
18	assess the impact of budget cuts	0.66
41	use resource loading and resources leveling to allocate resources to a project	0.70
50	interpret burnup and burndown charts	0.76
53	assess the implications of time constrained	1.00
58	create change orders	0.87
61	differentiate between top-down and bottom-up budgeting	0.72
75	allocate overhead to a project	0.67

4.2.7 Evaluating and closing

Evaluating and closing is the second least coherent cluster, containing nine statements (Tbl. 8). The bridging values range from 0.58 to 0.88 (M = 0.71, SD = 0.11), indicating that the cluster is rather diverse. Yet, most statements in this cluster are related to evaluating or closing a project, providing a fairly clear theme to the cluster.

Table 8: Evaluating and closing cluster

Statement		Bridging
5	close a project	0.74
36	explain the purpose of project control	0.59
42	produce an audit report	0.81
43	decide when to terminate a project	0.77
56	produce a project final report	0.63
57	handle scope creep	0.84
65	explain the plan-monitor-control cycle	0.58
68	explain the process of auditing a project	0.58
73	monitor project progress	0.88

4.3 Rating of statements

Rating results are shown in Table 9. In terms of importance, the highest rated clusters are *Evaluating and closing* and *Project manager*, indicating that learners consider these the most important aspects of the course. The clusters *Budgeting, Scheduling, Risk management and planning,* and *Success* are rated moderately important, whereas the *Projects* cluster statements receives the lowest average rating on importance.

Table. 9: Description of cluster ratings

Cluster	Importance			Ability		
	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range
Projects	2.46	0.45	1.79–3.07	2.60	0.63	1.93 – 3.57
Project manager	3.12	0.52	2.14–3.79	3.03	0.37	2.21 – 3.43
Success	2.72	0.50	1.86–3.71	3.04	0.31	2.43 – 3.43
Risk management and planning	2.82	0.48	2.00–3.50	3.11	0.43	2.21 – 3.86
Scheduling	2.89	0.39	2.21–3.43	3.25	0.40	2.21 – 3.86
Budgeting	2.93	0.35	2.29–3.43	2.74	0.61	1.57 – 3.43
Evaluating and closing	3.24	0.42	2.57–3.86	2.91	0.19	2.57 – 3.14

In terms of ability, the *Scheduling, Risk management and planning, Success*, and *Project manager* clusters receive rather high ratings, followed by *Evaluating and closing* and *Budgeting*. The *Projects* cluster comes last in the ability rating.

Evidenced by both a low Pearson product-moment correlation of $r = 0.36$ and the divergence between cluster rating values on either side (Figure 3), the average cluster ratings show a relatively low correlation across the two variables.

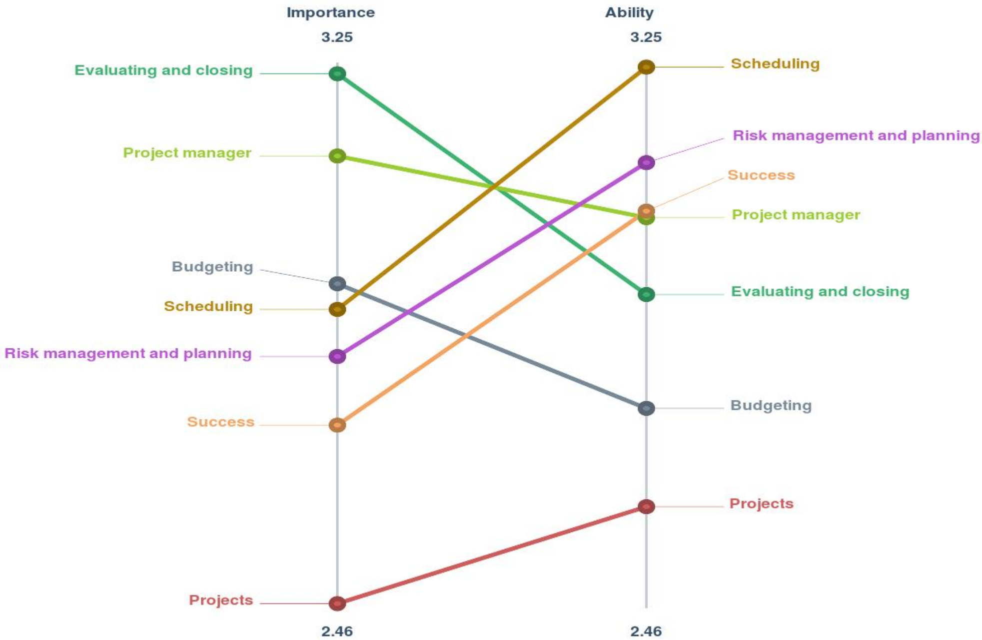

Figure 3: Pattern-match diagram

Importance and ability ratings are integrated into a scatterplot, the so-called go-zone diagrams (Figures 4–10). In the upper-right (i.e. the green) quadrant statements are shown which average ratings are higher on both importance and ability than the average rating of all statements. In the upper-left (i.e. the orange) quadrant statements are gathered that are perceived rather low in importance but high in self-assessed ability. The lower-left (i.e. the blue) quadrant plots statements that are perceived both low in importance and in ability. Finally, the lower-right (i.e. the yellow) quadrant contains statements that were rated high in importance and low in self-assessed ability.

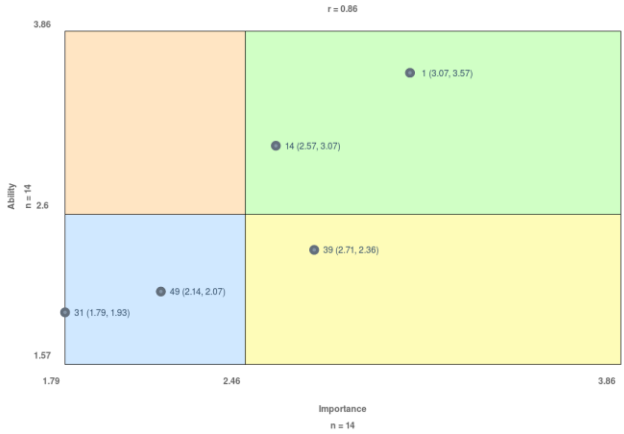

Figure 4: Go-zone diagram for the *Projects* cluster

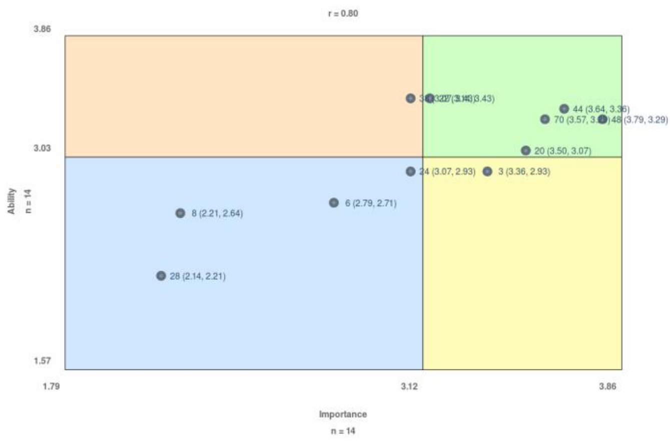

Figure 5: Go-zone diagram for the *Project manager* cluster

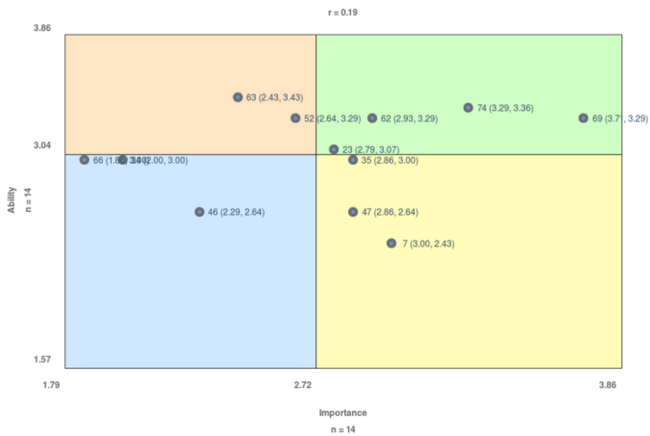

Figure 6: Go-zone diagram for the *Success* cluster

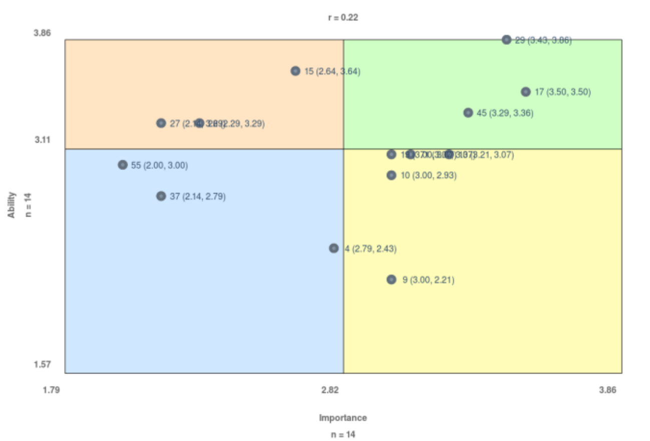

Figure 7: Go-zone diagram for the *Risk management and planning* cluster

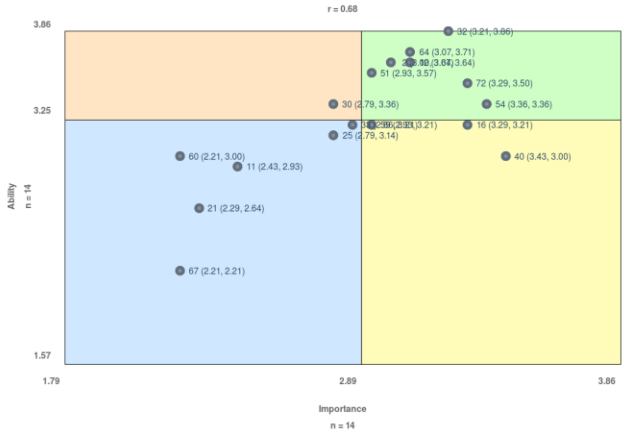

Figure 8: Go-zone diagram for the *Scheduling* cluster

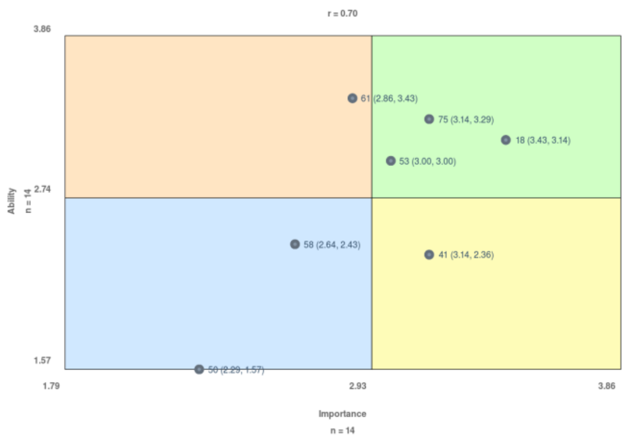

Figure 9: Go-zone diagram for the *Budgeting* cluster

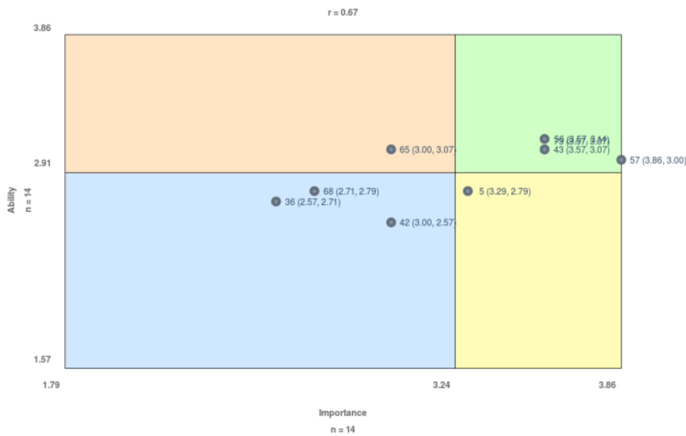

Figure 10: Go-zone diagram for the *Evaluating and closing* cluster

5 Discussion

5.1 Using cluster maps for planning effective interventions

The aim of this paper is to illustrate and discuss the GCM approach's merit in planning effective instructional interventions. The cluster map (Figure 2), which is one main result, visualizes whether learners comprehend the relationship between course contents and, thus, provides valuable insights for planning effective interventions.

The statements' bridging values (cf. Tables 2–8) indicate how frequently statements are sorted together. Recall, high values indicate that statements are not frequently placed together in sort piles. I.e., learners have different perceptions on how course contents relate to each other. That statements receive high bridging values can in part be traced back to the interconnectedness of course contents.

However, if the majority of learners in a course were lacking a fundamental understanding of how statements relate thematically to one another, the cluster results would surface such deficiencies through both very high bridging values and clusters that were very diverse in contents. An instructor would probably regard such a map as no good fit, revealing the learners' inability to comprehend thematical relationships between course contents.

Being unable to connect course contents, can have multiple reasons. Learners may not meet necessary pre-requisites or pre-requisites may not be defined correctly. Perhaps an instructor is not suited to teach the course, lacking either pedagogical competencies or subject knowledge. Yet another reason may be that learners did not fully engage in the learning process for any reason.

Though cluster maps themselves do not reveal reasons for a thematical misfit, they assist in identifying structural problems within a course. As the last stage of GCM includes map utilization, it is custom that results are shared with participants. Discussions with participants can generate further insights into where exactly learners have difficulties grasping course contents and how any issue can be addressed. This includes, for example, considering whether a course is relevant or placed correctly in the curriculum, an instructor needs to be replaced, learners need to be motivated, or how a course is designed. Exploring issues and alternative interventions in a participatory session facilitates pinpointing where an intervention is needed.

Because structural deficiencies normally have quite a negative impact on learning, effective interventions should probably focus on radically addressing the issues rather than trying to incrementally improve a course. Such radical interventions would have to be implemented in a timely manner.

5.2 Using rating results for planning effective interventions

Rating results can assist in planning effective instructional interventions too. Utilizing pattern-match and go-zone diagrams, instructors can gain very detailed information about where interventions are needed the most.

Recall, go-zone diagrams are divided into four quadrants. The upper-right (i.e. the green) quadrant indicates the area in which no immediate improvements are necessary. When resources are scarce, instructional interventions should not focus on statements in this quadrant because learners have already developed the ability to demonstrate the intended learning outcomes.

The upper-left (i.e. the orange) quadrant indicates areas in which learners most likely perform better than necessary. Thus, some concepts in this quadrant could either be de-prioritized or made more relevant to learners. The latter has the advantage that the learners are likely easy to motivate as they already have the necessary competences. When the relevance, i.e., the importance of the concepts, becomes clearer to learners, it could lead to a better overall learning experience. However, the learners' abilities in this quadrant are unlikely to improve very much. Therefore, this quadrant should not be the focus of instructional interventions.

The lower-left (i.e. the blue) quadrant indicates areas in which an assessment of the course contents might be needed. As this perhaps is more an exercise of removing course contents, not much energy should be put on instructional interventions in this quadrant.

The lower-right (i.e. the yellow) quadrant indicates areas in which interventions are needed the most. As learners consider these topics to be central but simultaneously lack the ability to demonstrate the necessary skills, instructional interventions are very likely needed and can potentially impact very effectively on student learning.

Whilst the lower-right quadrant indicates potentials for instructional interventions, not all statements in the area might require immediate action. To decide where to intervene, one should take a closer look at the relative position of a statement in a go-zone diagram. For this, it is suggested to split the diagram into three priority zones, drawing straight lines from the *average cluster importance* (B) to the *average cluster ability* (C) value, and from the *lowest average statement importance* (A) to the *average cluster ability* (C) value. Figure 11 shows such a split, illustrated by the *Risk management and planning* cluster.

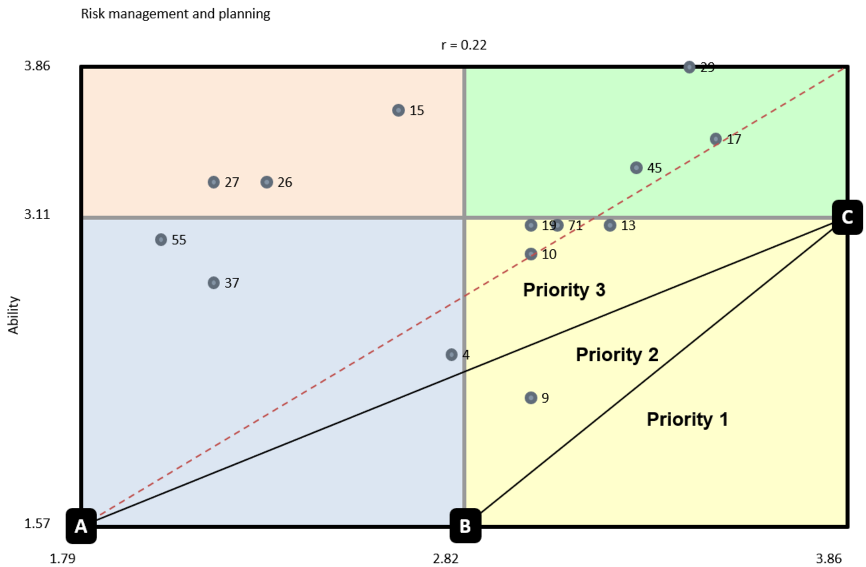

Figure 11: Priority zones for planning effective instructional interventions

Statements located in the *Priority 1* zone most likely require immediate interventions, if the statement is considered important by the instructor or institution and formal assessment results confirm that students lack the ability.

Statements in the *Priority 2* zone are of concern. But rather than planning immediate interventions, one should monitor how abilities develop over time before engaging in interventions after just one GCM cycle. Running another one or two cycles to confirm the location of statements would provide additional insights as to why the statement is placed here. If then the problem appears to be systematic (i.e. the statement persistently resides in the *Priority 2* zone) an instructional intervention would be appropriate.

Statements in the *Priority 3* zone are less of concern. In fact, most of them appear rather close to an imagined straight line between lowest and highest average values (shown as red-dotted line in Figure 11) and hence, rather well located in the diagram.

Figure 11 suggests that in the example cluster no immediate instructional interventions are required because no statement is placed in the *Priority 1* zone. However, statement 9 (*Conduct a Failure Mode and Effect Analysis (FMEA)*), resides in the *Priority 2* zone of the *Risk management and planning cluster*. If this is a topic that the instructor finds rather important and if formal assessment results confirmed that students lack the ability to conduct the FMEA, the suggestion would be to monitor this statement closely in the next round of GCM to ensure it is a systematic issue before planning an instructional intervention.

5.3 Limitations and future research

Whilst this paper has illustrated and discussed how GCM can be used to integrate the learner's perspective into planning effective instructional interventions, it has not focused on how to evaluate them. After planning an intervention and subsequently implementing it, it would be appropriate to evaluate its effectiveness. For this, rating data could be collected and analyzed to see if statements over time move to a higher priority zone. Statements moving upwards in go-zone diagrams would clearly indicate a higher attainment of intended learning outcomes. This could be studied in more detail in future research.

6 Conclusions

This paper has illustrated and discussed how GCM can be used to integrate a learner's perspective into planning effective instructional interventions. It has proposed how GCM results can enable HEI in prioritizing where to intervene and, hence, in directing their instructional intervention planning efforts. For this, sorting results assist in planning interventions of more structural nature, such as course contents and where to place a course in a program. Rating results, on the other hand, provide detailed insights into where learners need more support in attaining particular learning outcomes. Priority zones have been introduced, supporting decisionmakers in determining where to intervene, ensuring that any interventions impact the most on attaining intended learning outcomes and, thus, are effective.

7 References

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