Exploring Group Formation Strategies in Computer-Supported Collaborative Learning: A Systematic Review

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Abstract: In this study, three independent reviewers conducted a systematic review of articles on group formation strategies in computer-supported collaborative learning (CSCL) and synthesized and structuralized the involved grouping attributes and evaluation indicators with some other features. The study aims to contribute to efficient and effective group formation in educational practices in CSCL environments.

Keywords: Group formation strategies, computer-supported collaborative learning, systematic review

1. Introduction

With the proliferation of information and communication technologies (ICTs) and the far-reaching pandemic, CSCL has further developed in education, whose benefits when appropriately applied have been validated by substantial studies (Costaguta, 2015).

The group composition affects the learning outcomes and the group development lifecycle, which are crucial in fostering an effective and efficient CSCL setting (Krouska et al., 2019). Thus, exploring effective grouping strategies in the CSCL environment and their impact on CSCL becomes practically necessary.

Previous studies have focused on 2004-2018 articles about grouping strategies, while literature reviews evaluating the effects of those strategies are insufficient. Furthermore, although online learning has been integrated into pedagogical practices with unprecedented depth and scope since 2019 due to the pandemic, the group formation strategies in CSCL from 2019-2023 have not been deeply examined. Therefore, to fill the gaps and compare trends before and after the pandemic, the researchers searched articles on group formation strategies in CSCL in the past 12 years. Due to the time limitation and the concerns for comprehensiveness and credibility, Web of Science was chosen as the sole database for search. Hence, our research questions are as follows:

Q1: What group formation strategies have been adopted in the CSCL environment?

Q2: What has been the influence of those strategies on CSCL?

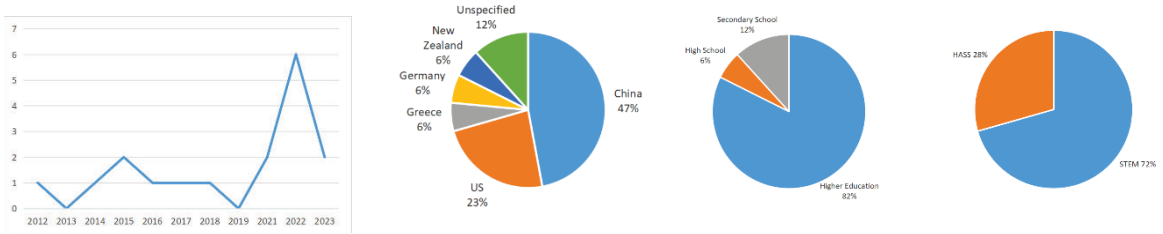
2. Method

In this study, the English-language journal articles or conference articles of group formation strategy in Computer-Supported Collaborative Learning that published from 2012 to 2023 were searched in the Web of Science database, and The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework and snowballing were the primary guide for this study. The three reviewers worked collectively to discuss the criteria of articles' inclusion and exclusion and independently coded articles, reaching a high level of consistency (Kendall's W = 0.81), and 17 articles were finally included. For the 17 final included articles, this study analyzed the basic information, counted the effect of group formation strategy, and used Theme analysis method analyzed the group formation strategy (Virginia et al., 2006).

3. Result and Discussion

3.1 Descriptive Information of the Literature

As for the time distribution (Fig 1. a), the number of published articles remained stable from 2012 to 2019 and showed a growing trend from 2019 to 2022. As for the country distribution (Fig 1. b), Chinese researchers paid more attention to research in this field. In terms of the distribution of the education stage (Fig 1. c), the research on group formation strategies in CSCL was mainly focused on higher education (82%). As for the subject distribution (Fig 1. d), group formation strategies in CSCL mainly focused on STEM disciplines (72%). As for the sample size, the number of participants presented a state of polarization, with the number of participants less than 50 and more than 200 accounting for the majority.

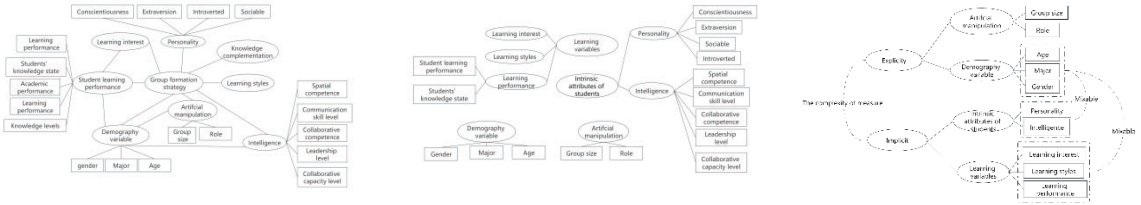


(a) *(b)* *(c)* *(d)*

Figure 1. The descriptive information graphs of the literatures

3.2 Group Formation Strategy

The initial codes had been distilled from the group formation strategies of the included articles and combined into an initial thematic web map (shown in Figure 2. a), describing the involved strategies from eight thematic dimensions, such as "Student Learning Performance" or "Personality." These themes are interdependent with links between them, such as "Spatial Competence" in "Intelligence" and "Gender" in "Demography Variable" (Zhong et al., 2023). Although differences and commonalities coexist in these eight themes, they were all retained temporarily before the sequent reviews.



(a) (b) (c)

Figure 2. The thematic web map

Next, the individual themes and the corresponding codes under the themes were verified and proofread, which formed Figure 2. b. The researcher incorporated “Personality" and "Intelligence" into the theme "Intrinsic Attributes of Students"; while “Learning Interest” and “Learning Style” and “Learning Performance” were included in the theme "Learning Variables". In addition, those highly similar codes, such as “Academic Performance” and “Learning Performance”, were merged into “Student Learning Performance”.

The final thematic network diagram was developed after the themes’ definitions and the ultimate optimization (Figure 2. c). The researchers found that those strategies could be divided into explicit attributes and implicit attributes according to the difficulty of their measurement. Explicit attributes are easy to obtain and measure, while implicit attributes

require specific measuring tools to obtain results which may have more options and may change with different measuring tools. Additionally, the demography variable belonging to explicit attributes can be mixed with the learning variable or the intrinsic attributes students belonging to implicit attributes together as group formation strategy rather than just alone.

3.3 The Evaluation of Group Formation Strategy

Most of the studies evaluated group formation strategies with different involved attributes using a mixture of indicators, some researchers reaching a consensus conclusion on the impact of the same group formation attributes, and some not. For example, As for the influence of gender as a group formation attribute, the researchers reached a consensus conclusion on the role of gender composition in groups regarding its influence on learners' attitudes. In addition, no consensus conclusion has been reached on the influence of learning style and achievement level as grouping attributes, which requires further research. Detailed information can be obtained from figure 3.

Group formation attributes		Gender					Role		Group size			
Evaluation indicators		Individual learning performance	Team achievement	Attitude	Cognitive process dimension	Problem-solving quality	Attitude	Cognitive load	Individual learning performance	Attitude	Cognitive load	Problem-solving quality
Conclusion	significantly		1	4	1		1	1	1	1	1	1
	no significant	1	1	1		1						

Group formation attributes		Achieving level			Learning style		Personality			Intelligence	
Evaluation indicators		Individual learning performance	Team Achievement	Attitude	Team achievement	Attitude	Individual learning performance	frequency of communication and member participation	Self-rated satisfaction	Individual learning performance	Attitude
Conclusion	significantly	1		1	1	1	1		1	1	1
	no significant	1	1		1			1			

Figure 3. The Involved Attributes of Group Formation Strategies and Evaluation Indicators

4. Conclusion

Based on a review of group formation strategies in the context of computer-supported collaborative learning from 2012 to 2023, this study constructed a theme map displaying the classification of the attributes involved in group formation strategies, analyzed the influence of the group formation strategies. The limitation of this study is that only one database was consulted for the data source of this study. Therefore, the data source should be expanded to include more literature to provide a broader and more holistic perspective in future studies.

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