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# Multimodal classroom interaction analysis using video-based methods of the pedagogical tactic of (un)grouping

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**ABSTRACT**

Grouping of people and/or things in school can involve challenging pedagogical problems and is a recurrent issue in research literature. Grouping of pupils sometimes aids learning, but detailed video-based analysis of how teachers (and pupils) group or ungroup (termed '(un)grouping') in classrooms is rare. This multimodal classroom interaction analysis study builds on previous work by exploring how the Pedagogy Analysis Framework can help untangle complicated classroom interactions involving (un)grouping and identifies sixteen types of (un)grouping. The sample size is one class of thirty pupils (10-year-olds), their class teacher, and teaching assistant. Four research methods were used (lesson video analysis, teacher verbal protocols, pupil group verbal protocols, and individual teacher interviews). Six hours of data were video recorded (managed using NVivo). Data were analysed by two educational researchers, the class teacher, and two groups of pupils (three girls and three boys). The methodology is Straussian Grounded Theory. Data were recorded in 2019. We present how often participants (un)grouped during a lesson. We propose and use a grounded theory for (un)grouping which we call the 'Exclusion, Segregation, Integration, and Inclusion (ESII) model'. Additionally, we discuss how misinformation and disinformation can complicate analysis of (un)grouping and examine different perspectives on (un)grouping.

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Video; pedagogy; analysis; grounded theory; grouping

## 1. Introduction

This research is about understanding and explaining complicated pedagogy in school classrooms, specifically the pedagogical tactic of "grouping and ungrouping", hereafter termed "(un)grouping". Schools gather pupils at the start of the school day and allow them to leave at the end. In-between many sorts of grouping happen: pupils entering their classroom, sitting at their table, meeting their friends at break, etc. Extracting a participant or participants from a group (including disbanding the group) is just as important a tactic as introducing a participant or participants to a group (including forming a new group). This theoretical paper uses multimodal classroom interaction analysis (Kress, 2010) and builds

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on our previous work (Hardman et al., 2022; Riordan, 2022; Riordan, Hardman and Cumbers, 2021; Riordan et al., 2021) through clarifying what types of (un)grouping there are by introducing an "Exclude, Segregate, Integrate or Include (ESII) model" (Figure 3) and showing how the extended Pedagogy Analysis Framework (Riordan et al., 2021) can be used to analyse the processes of (un)grouping. The ESII model is developed from a similar but simpler model in Hehir et al. (2016). This present work matters because theory may support experienced teachers as they make difficult judgements regarding complicated issues to do with grouping; new teachers can find some types of (un)grouping challenging (e.g. gaining the attention of a noisy class to begin an activity), and theoretical clarity may help teacher educators, and pedagogy researchers, in their work (see section 6.2). Our previous work (Riordan, 2022; Riordan, Hardman and Cumbers, 2021; and Riordan et al., 2021) found that classroom teachers (un)group occasionally during lessons (see Figure 2). This paper shows that understanding something as complicated as pedagogical (un)grouping is never going to be simple and we argue that our approach contributes another perspective on this issue to complement other work (see section 2.1).

A group can mean several people and/or things that are situated, collected, or classified together (OED). Many different types of grouping occur in schools such as streaming, setting, cross-age setting, "within class ability grouping", and "within class mixed ability" groupings according to Hallam et al. (2002). This present theoretical paper is concerned with the tactics of (un)grouping during school lessons rather than with any particular type of grouping. "Set theory" is a mathematical theory concerned with well-determined collections (called "sets") of objects termed members. Set theory became the standard foundation for mathematics as any mathematical object can be understood as a set (we acknowledge following McGee, 1997, that this issue is complicated). In this paper we use the term "group" (rather than "set" to avoid ambiguity in an educational context), but we understand the two terms to be synonymous and occasionally make use of set theory notation. We acknowledge that all four terms discussed later (exclusion, segregation, integration, and inclusion) are theory laden (Kuhn, 2012). The focus of this paper is on the tactics of (un)grouping not on the ethics of such behaviours (which is undoubtably important too).

Firstly, we situate this study in the research literature outlining what we know already about (un)grouping and what we do not know. Secondly, we explain the research design from which the data used in this paper emerged (multimodal classroom interaction analysis using video-based research methods and Straussian Grounded Theory). Thirdly, we present our findings alongside some thick descriptions illustrating how participants in one primary school lesson (un)group. Finally, we discuss the findings.

## 2. The theoretical approach

### *2.1. What we know*

#### *2.1.1. How can this research be situated in the research literature?*

This research involves multimodal classroom interaction analysis from the multiple perspectives of class teacher, pupil, and researcher. Incorporating the teacher's perspective into analysis is increasingly common according to Mercer (2010), but classroom research that combines the perspectives of teacher, groups of pupils, and

multiple researchers is rare. In multimodal classroom interaction analysis, like that pioneered by Kress (2010), classroom talk is considered alongside (and in relation to) other forms of communication such as facial expression, actions (e.g. a gesture such as raising a hand), and communicative interactions between people (i.e. pupils or the teacher) and the material objects of which a classroom is constituted (Hardman et al., 2022). To illustrate the latter point about communicating using material objects, we discussed in Hardman et al. (2022) how a pupil bent a mini whiteboard during a science lesson on chromatography, thereby explaining to the teacher the shape the chromatography paper had taken inside a beaker. The shape the paper had taken had caused a problem with the results of their experiment.

This present study can also be situated in the research literature about grouping practices and classroom management. That body of work acknowledges the challenging pedagogical problems teachers face managing groups of pupils in classrooms for activities, including learning (e.g. Blatchford & Russell, 2019). Much of the focus of this field has been on whether class size matters, and grouping is a recurrent issue in the literature (Blatchford, 2016). Galton et al. (2009) discuss reasons for the reluctance of some UK teachers to use group work and how this may have contributed to the popularity of direct instruction. They conclude that teaching using grouping can be as effective, and sometimes more effective, than using whole-class teaching. Group work is one teaching strategy among others, like individual work and discussions, considered in the literature to be effective in promoting learning (DeVries et al., 2020). Some research has investigated the management of group work in classrooms (e.g. Miller et al., 2017). However, fine detail multimodal interaction analysis using video of how teachers (and pupils) group others in real classrooms is uncommon. This paper uses video data from one primary school lesson with pupils aged 10, alongside video of teacher verbal protocols and pupil group verbal protocols (Taylor & Dionne, 2000).

### *2.1.2. What is the extended Pedagogy Analysis Framework (PAF)?*

The extended Pedagogy Analysis Framework (PAF) is a formal grounded theory for use in untangling multimodal interactions during lessons. It emerged in previous work (Riordan, 2022; Riordan, Hardman and Cumbers, 2021; Riordan et al., 2021) through the use of Straussian Grounded Theory Methods on video data from lessons, teacher verbal protocols, pupil group verbal protocols, and group interviews. The PAF consists of 11 interconnected elements (these elements are shown in bold with the letters in brackets referring to Figure 1 below) in the following subgroups:

(1) An interaction starts at a particular **time** ($t_0$) during a lesson, and the times at which further steps in that interaction occur can sometimes be identified (i.e. $time_1$, $time_2$, etc.). For example, at $time_0$ Ann realizes she has lost her pencil.
(2) Each **participant** (p; at the specified time), perceives a **context** (c) for this interaction. For example, the physical characteristics and positions of material objects like the pencil, pencil case, etc. in relation to Ann are all contextual factors, as is Ann's emotional state as she experiences this loss.
(3) Echoing insights from Conceptual Change literature (e.g. diSessa, 2006), **prior knowledge** ($k_0$) can influence an interaction. For example, if Ann was given the pencil as a present, that memory could influence her feelings now.

(4) Participants sometimes encounter a problem during an interaction (we call this the "problem route"). Drawing on Jonassen (2000) we discussed in Riordan et al. (2021) that a problem can be understood as a participant having a **known unknown** ($k_4$ $unk_3$) where they want (or do not want) to find that unknown (i.e. they have some **volition**; $v_2$). For example, Ann may know that she does not know where her pencil is, and she may really want to find it.
(5) In parallel with the previous point, sometimes a participant has already encountered and solved a problem such that this time they can instead implement a solution rather than start from scratch (this we term the "solution route"). Here the solution consists of a participant having a **known known** (i.e. $k_2$ $k_1$) where they want (or do not want) to enact what they know (i.e. they have, to some extent, **volition** to implement their solution; $v_1$). For example, Ann may know that she usually finds things where they are habitually kept, such as in her pencil case.
(6) In this multimodal classroom interaction analysis theory (i.e. the PAF) the way change happens (or not) is through a participant (or participants) using themselves or others (termed "human **means**"; e.g. Ann herself) and/or using material things (termed "non-human means"; e.g. a pencil).
(7) The way such means are used is called **strategy**, and that category is subdivided into simple actions (like picking up a pencil), through familiar sequences of actions called tactics (e.g. instructing someone to get a pencil), to complicated uses of means called "grand strategies" where a "thick description" (Geertz, 2008) is necessary to untangle what seems to be going on. For example, Bob (who has "borrowed" the pencil without Ann's knowledge) could be pretending that it is a train behind Ann's back in full knowledge that Ann is looking for her pencil.
(8) An outcome of the strategic use of means is called an "**end**". So, Ann could get her pencil back from Bob. However, intended means, intended strategies, and/or intended ends do not always happen, so the PAF uses the terms actualized means, actualized strategies, and/or actualized ends to accommodate this. For example, Ann could fail to get her pencil back from Bob.

The 11 elements of the PAF just described (i.e. p, t, c, $k_{0-4}$, $v_{1-2}$, $m_i$, $s_i$, $e_i$, $m_a$, $s_a$, $e_a$,; see Figure 1 below) emerged through coding hours of video data from school lessons, teacher verbal protocols, pupil group verbal protocols, and group interviews. These elements became part of the PAF because they proved useful in untangling these data (i.e. the philosophical foundations of Straussian Grounded Theory in pragmatism may be identified here). Coding happens by playing each video in software called NVivo, highlighting a short section of the video timeline, and dragging and dropping that section of video onto the relevant code or codes (i.e. a pragmatic approach to coding). For example, if a pencil is used, then that video segment will be dragged onto the "means > non-human > pencil" code (and if such a code does not yet exist it will simply be added at that point). This type of multimodal classroom interaction analysis using Straussian Grounded Theory on large sets of video data is therefore painstaking (e.g. coding 10 minutes of video can take as long as an hour) but can be fruitful. The PAF is illustrated in Figure 1 below.

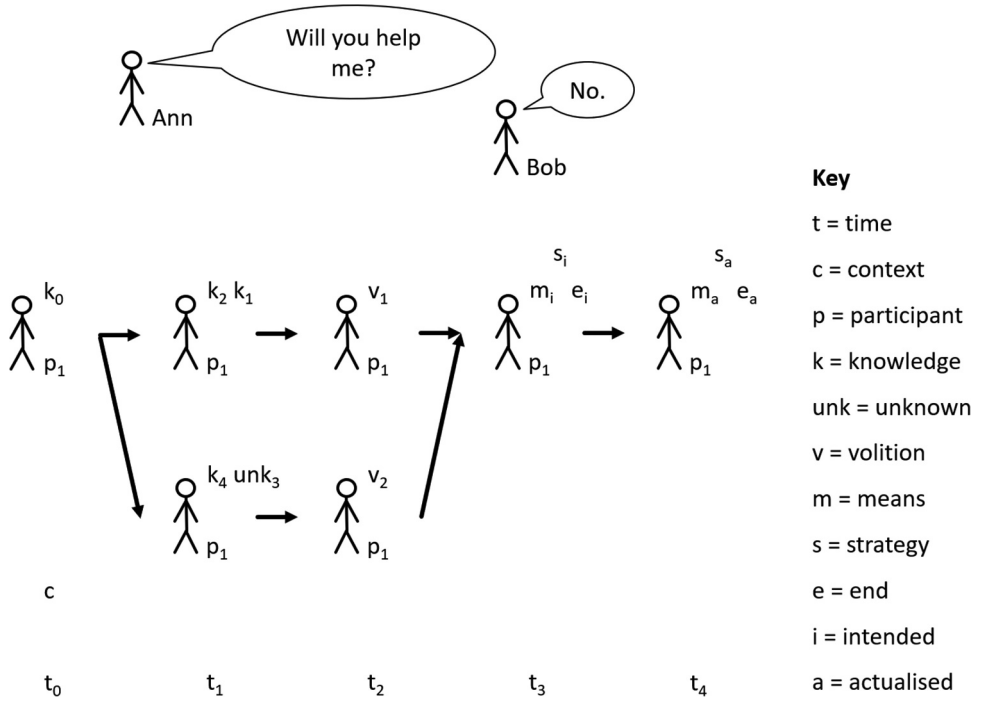


**Figure 1.** The extended pedagogy analysis framework.

(Un)grouping is one example of a pedagogical tactic that can sometimes become complicated to analyse. To explain (with an unsuccessful grouping example), in Figure 1 Ann (participant$_1$) is in a classroom (a context; c) and knows that Bob is not currently in her group ($k_0$). She knows she is struggling with something ($k_4$ $unk_3$) and wants to do something about that ($v_2$). She intends to ask Bob using her voice ($m_i$) for help ($e_i$) using a question ($s_i$). Though she does indeed speak ($m_a$) her question ($s_a$), she gets no help ($e_a \neq e_i$). Information passed without mishap from Ann to Bob. Timing can be significant regarding pedagogy analysis (see Riordan et al., 2021). The 11 elements of the PAF (i.e. $p_n$, $t_n$, c, $k_{0-4}$, $v_{1-2}$, $m_i$, $s_i$, $e_i$, $m_a$, $s_a$, $e_a$,) alongside the movements of information, misinformation, and disinformation (i, $i_m$, $i_d$) are, we think, useful when untangling simple and complicated pedagogy (Riordan et al., 2023). Such multimodal analysis needs "a sensitive, flexible theoretical framework" (Snyder, 1995, p. 45). We acknowledge that pedagogy in classrooms is not always difficult to analyse, but our focus is on the parts of a lesson where analysis does become complicated.

### *2.1.3. What is (un)grouping?*

Grouping was defined by Cohen and Lotan (2014, p. 1) as, "students working together in a group small enough so that everyone can participate in a clearly assigned learning task", but this focuses on the end point rather than on the process through which the group is formed (or unformed) which is the topic of this paper. Synonyms for group work include group learning, collaborative learning, cooperative learning, and peer learning according

to Gunderson and Moore (2008, p. 34). We understand (un)grouping to be a pedagogical tactic of sorting into, or removing from, a set. This analysis applies to both humans (e.g. a class of pupils) and/or non-human objects (e.g. a pencil case of pencils). So, (un)grouping involves a participant$_1$ (or participants$_1$), and another participant$_2$ (or group of participants$_2$), where the second group could include or not the first participant$_1$ (or participants$_1$) and/or a thing or things. For example, Ann could tell Bob and Kate to work together, or Ann could instruct Bob to work with her (Ann), or Ann could make a collection of round objects, or Ann (who has red hair) could group herself with some red things. Other sentient beings can group (e.g. Magpies collecting shiny objects), and some non-sentient things can group (e.g. a computer allocating children to schools using an algorithm), but that is not our concern here.

A concept is a group (i.e. a set). For example, identifying a pencil means noting the membership of this object in the set called "pencils" (Murphy, 2004). A set can be labelled or not, and in addition the set can be embodied or not. For example, a group of pupils labelled "gifted and talented" might also be placed on the "gifted and talented table" (usually euphemistically called the "penguin table" or similar) to work together. The demarcation between an element being a member of a group or not can be clear, as in prime numbers, or not, for example with the concept of middle age (termed fuzzy sets; Zadeh & Kacprzyk, 1992). Similarly, (un)grouping in school is sometimes definitive (e.g. permanent exclusion) and sometimes not (e.g. friendship groups).

> Natural languages are pervasively imprecise in the sense that in a natural language almost everything is a matter of degree. Imprecision of natural languages is rooted in imprecision of perceptions. (Zadeh, 2008, p. 2771)

Participants in classrooms may perceive the degree to which someone or something is a member (or not) of a group differently.

### 2.2. What we do not know

#### 2.2.1. Research questions

(1) What types of (un)grouping are there?
(2) How can the extended Pedagogy Analysis Framework (Riordan et al., 2021) be used to analyse the processes of (un)grouping?

This paper has outlined our theoretical approach, including what we know, and what we do not, and now explains the research design.

## 3. Research design

This video-based research used Straussian Grounded Theory to analyse the data collected using the four research methods outlined below. According to Corbin and Strauss (2008) the theoretical perspective underpinning Straussian Grounded Theory is symbolic interactionism, and the epistemology is social constructionism. We were trying to understand and explain classroom pedagogy (on a project about "science and religion encounters"), and "grouping" emerged during the course of the interactions and was then identified during the coding process, this led to the ESII model

below about potential types of (un)grouping (see Figure 3). This paper integrates those ideas about types of (un)grouping with the extended Pedagogy Analysis Framework (PAF), explained earlier, the latter being a formal grounded theory which developed through previous work using a similar research design (Riordan, 2022; Riordan, Hardman and Cumbers, 2021; Riordan et al., 2021). For more details about the PAF, please see the previous studies. Grounded Theories like these emerge using the following Grounded Theory Methods:

> [Initial] coding and categorization of data; concurrent data generation or collection and analysis; writing memos; theoretical sampling; constant comparative analysis using inductive and abductive logic; theoretical sensitivity; intermediate coding; selecting a core category; theoretical saturation; and theoretical integration. (Birks & Mills, 2011, p. 9)

The four research methods used were lesson video analysis, a teacher verbal protocol interview, a pupil group verbal protocol interview, and a researcher/teacher interview. Verbal protocols involve a participant or participants watching lesson video data and "thinking aloud". This method generates rich data and enables researchers to comprehend how participants understand incidents (Leighton, 2017). Data for this present paper were drawn from one primary school lesson with 10-year-old pupils. The lesson lasted one hour and occurred as it would normally in the school year. The teacher was encouraged to plan and teach as normal. We used three video cameras (two at the front and one at the back of the room) a lapel microphone on the teacher and a 360° microphone connected to one camera. Analysis began after the lesson and continued after the end of data gathering. Delay between the lesson and the follow-up teacher and pupil group verbal protocol interviews allowed time for analysis and pupil group verbal protocol video clip preparation (see section 6.3 about limitations). The video recorded teacher verbal protocol lasted about two hours, whilst the pupil group verbal protocol interview lasted 30 minutes. Video clips from the lesson were used in the pupil group verbal protocol interview for pragmatic reasons. We triangulated findings from the multiple perspectives of pupil, teacher, and researcher (Flick, 2018). We took a pragmatic approach to coding as recommended by Bryant and Charmaz (2010). For more on how we coded please see Riordan, Hardman and Cumbers (2021). Data were managed using NVivo. The teacher, an experienced primary colleague, was recruited by contacting nearby schools directly (a convenience sample). The teacher worked with her own class of thirty 10-year-old pupils. The pupil group verbal protocol interview was with six volunteers from the class (three girls and three boys).

We used Lincoln and Guba's (1985) concepts of "credibility", "transferability", "dependability", and "confirmability" to establish the trustworthiness of our findings. Credibility establishes whether the research findings represent a credible interpretation of the data. Transferability determines to what extent the findings can be transferred beyond this present study. Dependability ensures the integrated processes of data collection, data analysis, and generation of theory are carried out well. Confirmability is the degree to which the findings are supported by the data. We used the eight techniques proposed by Lincoln and Guba (1985, p. 219) and discussed in Riordan (2022) again during this present study. Research was designed and carried out within ethical guidelines (BERA, 2018) and ethics was approved by the university (ethics reference number ETH2021–0157) in advance of data collection. Data were recorded in 2019 in Kent in the UK.

## 4. Findings

### 4.1. How often do participants (un)group during lessons?

The following graph shows selected elements of the extended Pedagogy Analysis Framework relevant to (un)grouping (or helpful we think in understanding (un)grouping in context). If all the data collected and analysed in this present study was represented in one graph, that graph would be illegible. For example, in the six hours of video data we analysed for this project we coded 2,715 incidents in 291 different categories (using NVivo), hence the decision to show only selected elements below.

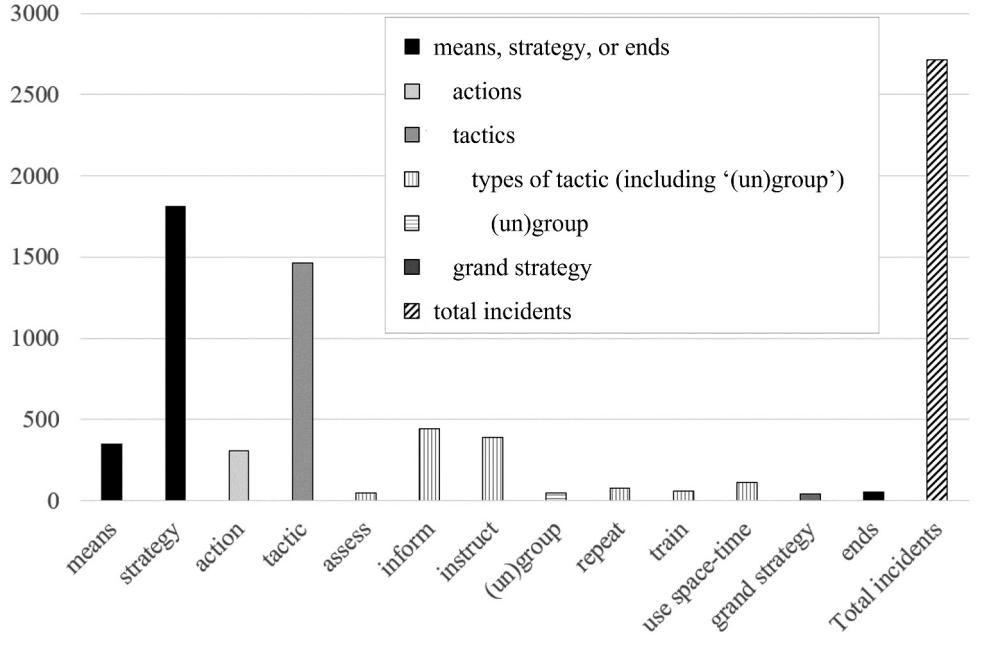


**Figure 2.** A graph of how often selected elements of the extended Pedagogy Analysis Framework were coded in the data (i.e. one lesson, one teacher verbal protocol interview, and one pupil group verbal protocol interview).

Out of 2,715 items coded in total, tactical grouping was coded only 47 times (see "(un) group" in Figure 2). The occurrence of grouping (i.e. the actualized end of (un)grouping) was coded only 12 times. Hence tactical grouping, and actual changes in groups, were both relatively rarely identified in these data. However, frequency with which an element of the PAF was coded does not necessarily correspond with the significance of an incident as regards learning. In line with the Straussian Grounded Theory methodology, (un) grouping emerged as a theme whilst these data were being collected and analysed, so we acknowledge reanalysis of these data might change the numbers of each category identified (known in grounded theory as "theoretical sensitivity"). We do not think that would change our basic point that (un)grouping did not occur very often in the data here.

### 4.2. The exclusion, segregation, integration, and inclusion (ESII) model

We now explain the "Exclusion, Segregation, Integration, and Inclusion" (ESII) model (Figure 3 below), another finding of this present study, which emerged from the data using the grounded theory methods described earlier. These processes include the Grounded Theory concept of "theoretical integration" where ideas from the literature are related to emergent findings (Birks & Mills, 2011). We acknowledge that this ESII model is partially developed from a simpler one in the United Nations Committee on the Rights of Persons with Disabilities general comment no. 4 cited in Hehir et al. (2016) and discussed in Riordan and Roberts (2021).

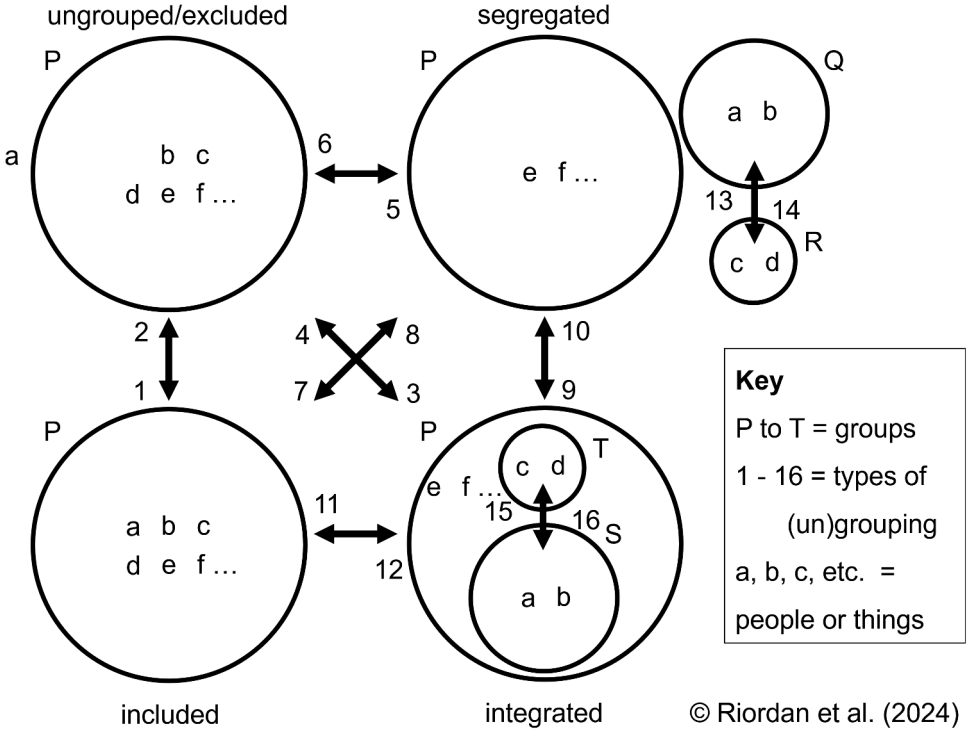


**Figure 3.** The exclusion, segregation, integration, and inclusion (ESII) model.

Next, we outline the ESII model before explaining it in more detail and illustrating how it works using an example. Firstly, an uppercase letter represents a group (P, Q, R, S, and T). Secondly, these are Venn diagrams, so a participant (or object) inside a circle (labelled a, b, c, d, e, f . . .) means the person (or thing) is a member of that set (i.e. grouped), and being outside the circle indicates the person or thing is not a member of that set (i.e. ungrouped). This simple model does not therefore include fuzzy logic as discussed earlier. Thirdly, arrows and numbers show the 16 ways in which (un)grouping can happen. For example, ungrouped or excluded participants (or things), can become part of set P via

route "1" (i.e. they are now included). Finally, in integration one group is a subset of another (i.e. Figure 3, "S is a subset of P" which can be written S ⊆ P) in contrast to segregation where two sets are "disjointed" (i.e. Figure 3, "Q is not a subset of P" or "Q ⊄ P"; sets P and Q have no members in common).

To illustrate using an example, pupils not permitted to attend a school because they did not pass a test is exclusion (Figure 3 type 2), taking the "lower attaining" pupils outside the classroom for an intervention is segregation (Figure 3 type 8), grouping these same pupils on a table in a classroom is integration (Figure 3 type 12), and attending school in a mixed-attainment class is inclusion (Figure 3 type 1). We acknowledge that all these terms are theory laden, such issues are far from simple, and emphasize again that our focus is not on the ethical aspects of (un)grouping (which are of course important) but on the pedagogical tactic itself.

### 4.3. Explaining more complicated (un)grouping using the extended pedagogy analysis framework

More complicated (un)grouping tactics might involve misinformation and/or disinformation (i.e. accidentally wrong information or deliberately wrong information, both discussed in our earlier work; Riordan et al., 2023), and/or disagreement (perhaps including conflict). To return to our example from earlier, Ann might be mistaken that she cannot manage alone (perhaps based on misinformation). Bob may intend to help and his "No." may be deception (disinformation). Additionally, he may be stoking conflict (i.e. disagreement accompanied by negative emotions and interference; Barki & Hartwick, 2004) in Ann (i.e. "winding her up") for his own entertainment (another intended $end_i$). As we have noted before, most of the time pedagogy analysis is relatively straightforward, but not always, and during complicated interactions the theories in this present paper might help during analysis as we will illustrate later with a thick description of incidents from a lesson. Participants may agree or disagree (including sometimes being in conflict) about past or present grouping (e.g. if someone is integrated or segregated) and/or about the intention of a grouping intervention (e.g. if the intention is to exclude (Figure 3, "6"), include ("7") or integrate ("9")). Hence the theory about (un)grouping in this present paper should be integrated with a discussion about disagreement (including conflict).

### 4.4. Perspectives on (un)grouping

(Un)grouping can be perceived from the perspectives of those already in the group who remain in the group, those who are (un)grouped, or those never in the group. For example, the entry of a new pupil into a club run by a teacher, could be perceived from the perspectives of the teacher (already part of the club), the new pupil, or a pupil who is not a member of this club. Hence, for each of the 16 "types of (un)grouping" in Figure 3, there are 3 potential vantage points, leading to 48 permutations.

## 5. Thick description

After the following lesson transcript passage, which lasted in total one minute and seven seconds, we give a thick description to illustrate the use of theories about (un)grouping

described earlier (sections 4.2 to 4.4). The purpose of the following analysis is to demonstrate how using the PAF and the ESII model together can help understand and explain how teachers (un)group during complicated interactions during lessons. The lesson lasted 60 minutes, so this extract represents about 2% of the data analysed. This passage was selected as it is rich illustrating 27 elements of the PAF and 3 types of (un)grouping, but several other sections of the lesson could equally well have been used. No suggestion is made here that any participant themselves would untangle these interactions in this way whilst the lesson was going on. The lesson is about the Big Bang Theory and these 10-year-old children are about to do a role play in small groups to explain the theory.

> L2 18:57–20:04 **PT1** (Primary Teacher 1): So, you are going to be split into groups of ish [PT1 gestures uncertainty by wobbling her hand] seven or eight. So, are you all – girls [said with a stern voice to reprimand talking and bring the miscreants back into the group – short pause] – are you all going to start off together in that singularity? [PT1 gestures a small entity with her hands] If people are going to play different things, how are they going to go out and be those things? What are you going to represent? How are we going to know as your audience what you're representing through your acting? Do you want a narrator – to be speaking over and explaining? Or are you the people in it going to explain [PT1 signs the word "explain" with her hands] as you do things? Or is it going to be silent? It's entirely up to you how you create it [i.e., the roleplay about the Big Bang]. OK? But you need to think about your audience. There are three groups [Name of a $pupil_1$ said by PT1 to attract their attention] and then you will show us your creation. Now what the two groups watching are going to be thinking is, "Does that explain how [the Big Bang happened]?" That's what we're thinking about today. How [word emphasised by being said slightly louder] does this happen? Alright?
>
> 19:51 **PT1**: So, could [$pupil_2$] and [$pupil_3$] go and join [$pupil_4$'s] table. You can make an eight over there [$pupil_2$ and $pupil_3$ stand up and join $pupil_4$ at the other table]. That means that [$pupil_5$'s] and [$pupil_6$'s] group can combine together to make an eight [PT1 signs with her hands to indicate the two groups coming together], and you three [$pupils_{7–9}$] can go and join the table behind you and you will be a seven, I'm afraid, instead of an eight. [The pupils move to their groups – tables and chairs are moved out of the way]

This teacher is speaking with the whole class as a group and tells the pupils that they will soon be put into small groups (i.e. the tactic is to **$inform_1$**; elements of the PAF will appear in bold type like this). This future transition from whole class teaching to group work can be described using the ESII model type **12** (i.e. a transition from an included state to an integrated state; see Figure 3; (un)grouping types will also be shown in bold like this). Then the teacher begins a **$question_1$** but pauses briefly to reprimand a small subgroup in the class who are not paying attention. The word "girls" can be interpreted to mean, "stop talking and listen" (hence "**$instruct_1$**"), and the teacher is disbanding the subgroup of the "girls" (i.e. Figure 3 type **11**). The teacher completes the first question and accompanies it with a gesture (an **$action_1$** indicating the concept "together"). There follow six **$questions_{2-7}$** prompting the pupils to think about how they will organize themselves as a group (**$question_6$** is accompanied by another **$action_2$** indicating "explain"). This teacher then **$informs_2$** the pupils that they are free to do the role play as they like. After a brief **$question_8$** to see if they are happy with this arrangement, she **$informs_3$** the pupils that they must be conscious of their audience's needs (thus highlighting how this teacher wants one subgroup, the small group, to interact with another subgroup, the audience). Next the teacher **$informs_4$** the pupils that there will be three groups, before pausing mid question to attract the attention of a wayward pupil. The use of the pupils' name conveys

the meaning "pay attention" so we interpret this tactic as **instruct$_2$** and the transition as "to cause a participant who is ungrouped to become included in a group" (i.e. Figure 3 type **1**). Next the teacher **informs$_5$** using the subcategory of "**disinform**" (i.e. uses information that is deliberately wrong) with a further subcategory called "**invent**" where a participant displays a different reality (information, misinformation, and disinformation in the classroom was discussed in Riordan et al., 2023). Here the teacher tells the pupils what pupils in the other groups will be thinking (i.e. "Does that explain how [the Big Bang happened]?" This point is stressed by the teacher **informing$_6$** the class that this is the focus of the lesson, and then repeating the **question$_9$** with a slightly different phrasing (i.e. "How [word emphasised by being said slightly louder] does this [i.e. the Big Bang] happen?"). A further **question$_{10}$** checks briefly how the pupils are before some physical (un)grouping begins.

Next this teacher **instructs$_3$** pupil$_2$ and pupil$_3$ to go and join pupil$_4$'s table, so this is the beginning of the actualization of the aforementioned (un)grouping from a state of being included to being integrated (i.e. Figure 3 type **12**). She **informs$_7$** the class how big that group will be and adds a gesture (pointing; **action$_3$**) to show where that group will reside. Then the teacher combines two subgroups (with another "together" gesture; **action$_4$**) which can be modelled as two type **15** transitions (i.e. from one subgroup to another subgroup). This (un)grouping sequence finishes with another two subgroups being combined with the same sort of transition type (Figure 3 type **15**). Hence, in these 67 seconds this teacher has used 27 elements of the PAF and 3 types of (un)grouping. The elements of the PAF are four types of "**means**" (i.e. voice, teacher's hands, tables, and chairs), three types of **actions** (all gestures; one done twice), and 20 types of **tactic** (**inform** (x7), **question** (x10), and **instruct** (x3)). The types of (un)grouping from Figure 3 are **12**, **11**, **1**, and **12** (repeated). (Un)grouping is itself a type of "instruct" tactic. A grand strategy is a set of incidents where a rich narrative (a thick description) is necessary to understand what has occurred, so the transcript passage above can be identified as such.

Having done the basic analysis above of the short transcript excerpt using the PAF and ESII models, we can now ask how the (un)grouping here influences elements of the PAF (most importantly the actualized end of "learning") and vice versa. Firstly, (un)grouping can influence learning (i.e. as an intended end). The premature splintering of the whole group into subgroups (e.g. the "girls" and the rest of the class, or the boy who is named later and the class) through "challenging behaviour" risked we suggest, from the teachers' perspective, learners failing to understand the task so that her intended end would have been less likely to have been achieved. This is a potential argument for the Figure 3 type **11** and type **1** (un)grouping tactics described above, which can now be compared with the reasoning participants give about these behaviours in the corresponding Teacher Verbal Protocol and/or Pupil Group Verbal Protocol interviews. Obviously, participants in the lesson have much less time to analyse what is going on than participants doing video analysis of the lesson afterwards (namely the teacher, the small group of pupils, and the researchers). Most of the time in-depth analysis is unnecessary to understand and explain interactions, but sometimes it is as, we suggest, in the passage above. Secondly, (un)grouping can be in response to an unactualized end. For example, later in this section of the lesson one subgroup fail to prepare independently a role play in the allotted time so the teacher sends the group outside the classroom with an instruction to sort themselves

out, a warning, and the Teaching Assistant for support (i.e. this subgroup are segregated from a state of being included or Figure 3 type 10). Hence the PAF and ESII are intimately connected and multimodal classroom interaction analysis of complicated pedagogy in classrooms involving (un)grouping may sometimes need both.

Triangulating using multiple perspectives of teacher, pupil, and researcher can sometimes be important when analysing classroom interactions (Carter et al., 2014). To illustrate this point there follows a short extract from the corresponding Teacher Verbal Protocol and then one from the Pupil Group Verbal Protocol concerning (un) grouping.

> TVP2 43:43–45:03 **PT1** (Primary Teacher 1): [The teacher has just watched the passage above back on video and pauses the video to speak] Sometimes I let them choose their own groups, but they're quite an interesting mix as a class which [PT1 points at one of the groups on the laptop screen] you spotted from that group over there [the group mentioned above who were later segregated]. There are children who just clash so much [PT1 is shaking her head slightly] that as soon as you put them into a group you know it is going to be a disaster. So, it is a rod for my own back, that third group was always going to be a problem, because that was sort of the core of like [PT1 is gesturing with her hands pupils forming into a group] … We said about [$pupil_5$] that she was like … well yeah … but she is … and then some of the other children in that group who … at one point I did take something off [$pupil_6$] then somebody [$pupil_7$] has turned round the wrong way. They were always going to be the group that had more issues. But if I'd split them across three groups then all three groups would have had issues. So at least we could have two groups getting on [PT1 is miming with her hands two groups in one part of the room and the third group in another place], doing a lovely job, creating this [i.e., the roleplay], and then we could have the adult support into the third group as needed. So, you know [PT1 gestures with her head to perhaps indicate the difficult decision involved here] – a choice that I knew would backfire, but it kind of had to backfire because somebody had to have that particular collection of people. So – bless them – they're just not very good with groups … as a whole. On their own, work their socks off – brilliant. Group work they find tough. So, it is something they have got to learn to do. They will have to do it through secondary school. So, we might as well get it into the learning. To try and help them understand the dynamics of how they can work together. So, lots of learning going on in this one! [PT1 and JPR smile; PT1 restarts the video]

Next, rather than analyse this passage in the same detail as before, we pick out two important themes to illustrate why teacher (and pupil group) verbal protocol data is so important in pedagogy analysis. Firstly, the teacher clarifies the context within which she has made her (un)grouping decisions. For example, she sometimes allows pupils to choose their group, and some children in this class struggle with working in groups (occasionally involving disagreement and perhaps conflict). "There are children who just clash so much that as soon as you put them into a group you know it is going to be a disaster." Secondly, she knows that putting the pupils who find it difficult to work in a group in the same group would be problematic ("a rod for my own back") but makes four arguments for why she did this. Grouping the pupils who struggle with group work together meant the other two groups were more likely to succeed, the adult support could be better targeted on those who needed it, this collection of pupils needed to be grouped somehow, and group work involves skills these pupils need to learn for the future ("To try and help them understand the dynamics of how they can work together"). We argue that it simply is not possible to understand complicated interactions regarding (un)grouping like the one analysed above

sufficiently without listening to how participants themselves explain what they think is happening.

The following short extract from the Pupil Group Verbal Protocol interview is an example of how the pupils' perspective on the lesson can give valuable insights.

> PGVP2 19:09–19:24 [The group of six pupils have just been watching the video of the groupwork. One pupil talks over the video whilst it continues to play] $pupil_8$: This is – I think this is when we go outside . . .
>
> $pupil_9$: Yeah
>
> $pupil_8$: . . . because [the teaching assistant] advised us because there wasn't enough space in the class.
>
> $pupil_{10}$: And because [$pupil_{11}$; who has learning difficulties] would not normally be in there with the loud noise [$pupil_{10}$ points to her ear].
>
> $pupil_8$: Because it was too loud for [$pupil_{11}$].

A $pupil_8$ describes the (un)grouping (a transition from being integrated in the lesson to being segregated; Figure 3 type 10) and that the teaching assistant has justified this move to the group based on lack of space. This is an example of pedagogy involving the interactions of people with other people, and people with physical things (like the classroom environment). Another $pupil_9$ agrees with $pupil_8$'s analysis. Then yet another $pupil_{10}$, whilst agreeing with that point argues that a further justification is that a member of that group who has learning difficulties ($pupil_{11}$) normally needs a quieter environment. $Pupil_8$ concurs. When analysing classrooms during noisy practical activities it can be hard to untangle what is happening and why, and verbal protocols by pupils working as a group can provide useful insights.

## 6. Discussion

The PAF and ESII models can help understand and explain (un)grouping incidents during classroom lessons, and participant video-based multimodal analyses of such incidents. It should not be underestimated how complicated pedagogy analysis of such incidents can get and data from multiple perspectives (e.g. teacher, pupils, and researcher) can be needed. The PAF and ESII grounded theories are necessary for pedagogy analysis of (un) grouping behaviours but are not always sufficient. Sometimes other theory will be required. For example, we think the PAF and ESII are not sufficient to understand and explain classroom disagreement (including conflict) so we will address that topic in a future paper.

Pedagogy analysis of (un)grouping matters for several reasons. Firstly, our earlier work indicated that this is a basic pedagogical tactic, so understanding and explaining it could be important for new and experienced teachers and educational researchers (Riordan, 2022; Riordan, Hardman and Cumbers, 2021; Riordan et al., 2021). Secondly, the findings in this paper combined with those in previous papers as we have discussed above, show that (un)grouping can sometimes be complicated to understand and explain, and to do. Finally, though we have deliberately not discussed the ethics of (un)grouping in this paper as that is not the focus of this work, we hope this

analysis may contribute to such research which should acknowledge how challenging (un)grouping can sometimes be for participants in classrooms.

We argue that the PAF, now augmented with the (un)grouping theory developed in this paper, can be useful in analysing other aspects of pedagogy. For example, differentiation is not a phenomenon in need of a separate "ad hoc" theory according to this way of thinking. It involves two pedagogical problems for a teacher (Riordan et al., 2021). Firstly, how can the likelihood of learning for each participant in a classroom during a lesson be maximized? Secondly, how might (un)grouping during that lesson facilitate the first objective? Individual solutions to the first objective with typical class sizes are probably unnecessary and would be likely to overwhelm the educators, so the second objective is pragmatic. The PAF can then be used to identify different types of differentiation like "by outcome" (i.e. grouping by intended end), "by activity" (i.e. grouping by strategy), "by resources" (i.e. grouping by means), etc. This is an example of what Darden (1991) called "lack of ad hocness" (Darden, 1991) which she identified as a method for theory assessment.

> Simplicity in the sense of lack of numerous ad hoc hypothesis is often claimed to be a mark of good theories. Darden 1991 p. 264.

This present paper explored only what types of (un)grouping there are and how the PAF (with the ESII model) can help (un)grouping analysis, and there are many other important aspects of (un)grouping which are beyond the scope of this paper. We give three examples. Firstly, the processes of (un)grouping and the state of being, or not being, grouped can have emotions associated with them. So, when someone is made to feel welcome in a new group this is likely to have implications for future interactions (friendship groups forming etc.). Furthermore, the perception that one is a member of a group or not can influence future interactions (e.g. "top set" arrogance). So, the issue of emotion and (un)grouping is obviously important too. Secondly, the focus of this paper is on active (un)grouping by participants in classrooms, but (un)grouping can occur because of other mechanisms which can also be important. For example, some birds fly in a "v" formation which may be an emergent aerodynamic phenomenon and/or a social/perceptual effect (Bajec & Heppner, 2009, p. 779). In potentially a similar way pupils moving through congested school corridors might group unconsciously. Thirdly, sometimes the physical environment (un)groups either deliberately or accidentally. For example, chairs and tables placed in a room will tend to group people who enter in the current arrangement (though mobile furniture may sometimes be moved of course). Sometimes the physical environment causes grouping accidentally. For example, a low hanging branch over one route where a path bifurcates might tend to separate the tall from the short.

### 6.1. Originality

We argue, using the criteria for originality identified by Wellington (2012) that this paper has the following innovative aspects. Firstly, this study builds new knowledge by extending previous theory (the PAF) into the field of classroom (un) grouping and develops the diagram from Hehir et al. (2016) into the ESII model. Secondly, to the best of our knowledge multimodal classroom interaction analysis using Straussian Grounded Theory of (un)grouping from multiple perspectives has

not been done before. Finally, pedagogical (un)grouping is a recurrent issue in the literature and this paper offers a new theoretical approach.

### 6.2. Significance

This multimodal classroom interaction analysis research is important as it responds to what Mercer (2010, p. 10) described as, "a pressing need to provide more strong empirical evidence of how involvement in talk affects educational outcomes." In this present study the focus is on the tactical use of (un)grouping to bring about small-scale outcomes during a classroom lesson rather than on bigger outcomes like results in national tests, but we suspect that those bigger achievements rest, to some extent, on a foundation of the small every day learning successes in the school classroom.

Earlier (section 2.1.1) we noted that classroom research like Miller et al. (2017), who investigated the management of group work in classrooms, is uncommon and that there is evidence that grouping can be an effective classroom tactic for promoting learning (DeVries et al., 2020). Hence the ESII model (Figure 3) that emerged during this present research contributes to an under-researched field into an area of pedagogy of importance to classroom teachers.

### 6.3. Limitations

The most significant limitations remaining are as follows. Firstly, many technical challenges remain with this sort of research, particularly with audio quality from noisy classrooms. Secondly, this paper provides theory to help with pedagogy analysis of (un) grouping in classrooms, but there are many other aspects of (un)grouping which are beyond the scope of this paper (as discussed in section 6).

### 6.4. Next steps

We are investigating ethical pedagogy (regarding sustainability and decoloniality) and disagreement (including conflict) in the classroom.

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## Data availability statement

The data that support the findings of this study are available in the UK Data Service "ReShare" (https://reshare.ukdataservice.ac.uk/) at http://doi.org/10.5255/UKDA-SN-854915.

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