Pedagogical literacies: A hidden benefit of the jigsaw technique

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Abstract:

The jigsaw technique is a cooperative learning method in which students become "experts" in different areas, before sharing their expertise in "jigsaw" groups (Aronson & Patnoe 2011). It has become well established in primary and secondary classrooms, and is increasingly advocated in higher education. However, little is known about the specific impact of the technique on the pedagogical literacies of students and teaching staff. In this study, a series of five action research cycles was implemented, in order to investigate the technique across a range of disciplines. The findings clearly point to a positive impact on pedagogical literacies for both students and staff. Benefits for students included greater engagement with the topic and reflection on their learning conditions, and the acquisition of real-world skills. Staff reported opportunities for expansion of their pedagogical repertoire and facilitation of student-centred learning. It is therefore argued that higher education practitioners in diverse disciplines should make increased use of the jigsaw technique.

Key words:

jigsaw; cooperative learning; pedagogical literacy; approaches to learning; engagement; cooperation; active learning.

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Introduction

Since its development in the US school system in the 1970s, the jigsaw technique has become well established in primary and secondary education in numerous contexts (Sharan 2010). Use of the technique is also well documented in the higher education literature. Jigsaw-style activities have been included in recent studies on self-efficacy (Crone & Portillo 2013), proactivity (García-Almeida & Cabrera-Nuez 2020) and engagement (Hermann 2013). This study, however, investigates the technique's potential effect on pedagogical literacies (Maclellan 2008; Cajkler & Wood 2016), an underexplored dimension in higher education teaching and learning. The aims were to investigate the impact of the jigsaw on the development of pedagogical literacies for both students and teaching staff at a UK university, across a range of subject disciplines.

The jigsaw technique: background

The jigsaw technique was devised in the 1970s to address the "hostility and prejudice" which had arisen in urban schools in Austin, Texas, in the immediate aftermath of desegregation (Aronson & Patnoe 2011, p. xv). The interactive, student-centred technique offered an alternative to what Aronson and Patnoe perceived as the "competitiveness" of the traditional teacher-centred classroom. In its original form, the jigsaw procedure can be summarised as follows: first, students form "jigsaw" groups, usually with 5-6 members. Within the groups, each student is given responsibility for a particular segment of material, e.g. a part of a longer text, or element of a discussion topic. In order to become "experts" in their particular segment, the individual students then regroup, so that they are now with their counterparts who are focusing on the same segment. In these "expert groups", they are given time for discussion. In the third step, students then return to their "jigsaw" groups and the representatives of each different "expert group" are given opportunities to share their knowledge of the segment they have been working on, with each segment being considered in turn. In a final stage, the

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instructor may choose to revise the material through a whole-class plenary or quiz.

The perceived benefits of the jigsaw technique are well documented in the literature on cooperative learning in primary and secondary education. For example, Johnson, et al. (2000, p. 12) provide evidence that the use of the jigsaw technique leads to greater achievement than competitive or individual activities. Sharan (2010) also acknowledges the technique's prominent position in the cooperative learning literature, pointing out its "documented effects on academic achievement and social relationships" (2010, p. 6). Furthermore, it has been argued that the jigsaw's fostering of interdependence makes it more successful than standard cooperative methods, not only enhancing student achievement but also improving inter-group relations, and reducing prejudice (Walker & Crogan 1998). Other studies have focused on the benefits of the jigsaw technique for increased self-efficacy (Darnon et al. 2012), as well as inter-group engagement in intercultural contexts (Santos Rego & Moledo 2005). Finally, there is evidence (Artut & Tarim 2007; Wedman et al. 1996) that jigsaw-based approaches are beneficial in pedagogical knowledge development for pre-service schoolteachers.

Criticism of the jigsaw technique in primary and secondary education tends to question whether there is sufficient evidence for its beneficial effects. For example, Bratt (2008) found no evidence of effects on intergroup relations in a two-part study of classes in Norway at both elementary and high school level, and Slavin and Cooper (1999) cast doubt on existing findings regarding intergroup relations, calling for a modified version of the original technique, Jigsaw II, which introduces final team scores after completion of the jigsaw task, aligning it with other cooperative learning methods. Furthermore, other permutations of the jigsaw technique have since been proposed, including Hedeen's Reverse Jigsaw (2003) which allows each group to report their

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findings in a final whole-class presentation stage intended to widen critical discussion and further democratise the learning process.

Application of the jigsaw technique in higher education

Crone and Portillo (2013) extended investigations of the jigsaw technique to higher education, with a specific focus on students' self-beliefs. Effects on students' academic self-efficacy were found, with students who had experienced jigsaw activities reporting higher levels of confidence and self-belief at least in the short term, but no effect on academic performance. Conversely, Perkins and Saris (2001) reported a statistically significant increase in test scores when jigsaw exercises were implemented on undergraduate courses in statistics. Furthermore, in a study of two undergraduate courses in principles of management, García-Almeida and Cabrera-Nuez (2020) used the jigsaw technique to demonstrate that self-efficacy, as well as a students' internal locus of control, are key determinants of academic achievement in the context of cooperative learning activities. Overall, despite differing findings on achievement, all of these studies firmly locate the jigsaw technique within cooperative learning at higher education level as a means of enhancing students' self-confidence.

That the jigsaw technique is viewed positively by higher education practitioners is evident in its regular inclusion among active learning strategies recommended by universities to their teaching staff. Typically, jigsaw activities are advocated for the support they give to students' confidence, with students feeling more comfortable in the final jigsaw step through having been able to practise in their expert groups (Berkeley Centre for Teaching & Learning 2020). Greater time-efficiency has also been proposed, as well as the benefits to students of taking individual responsibility within their jigsaw group (ABLConnect 2020).

These proposed benefits are reflected in the higher education literature, in a wide range of disciplines. In the social sciences Hedeen's reverse jigsaw variant (2003) aims to develop communication skills as well as critical

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thinking, whilst Benton's jigsaw-based reading groups on an MBA course foster, according to student participants, responsibility "for determining the most important points in a reading and being able to articulate them" to their peers, rather than "procrastinating all reading until the end of the quarter and then trying to catch up" (2016, p. 42). In social work education, Steiner et al. (1999, p. 261) cogently advocate the use of cooperative learning strategies, including the jigsaw, not only to "increase students' knowledge base, but to make them more effective analysts and mediators of complex social situations". This establishes a link not only to communicative competence but also, ultimately, employability, in the form of professional development for real-world situations. Furthermore, Tarhan and Sesen (2012) report that jigsaw methods enhanced conceptual understanding for first-year undergraduates in chemistry, echoing previous findings for students of electrochemistry (Doymus et al. 2010), and McQueen and Macmillan describe jigsaw discussions as "an effective method for incorporating personalisation" into second-year biology lectures (*in press*, p. 12).

It is, however, important to bear in mind Herrmann's account of "ambiguous and contradictory" findings in relation to cooperative learning in higher education research (2013, p. 176) citing negative interdependence, unequal participation (i.e. free-riding) and distrust of information received from peers identified as key themes. With specific reference to jigsaw activities, these factors could perhaps be related to a previous finding (Giles et al. 2006, p. 217) that students on an introductory university statistics course gave higher overall ratings to teacher-centred classes compared to student-centred classes which included jigsaw tasks. Indeed in Hermann's own study of engagement levels in a cohort of 140 undergraduates, 45% of respondents were categorised as having a negative view of cooperative learning activities. He warns against an over-emphasis on cooperative learning "structures", including the jigsaw technique (2013, p.183) without consideration of individual students' concerns about the drawbacks of peer interaction. His final recommendation that teachers need to "invest time carefully explaining

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the intention and purpose of cooperative learning" (p. 184), i.e. discussing pedagogical practice directly with students, is particularly cogent.

Pedagogical literacies

Building on well-established notions of academic and societal literacies, Maclellan (2008, p. 1987) calls for teachers to pay greater attention to the specific nature of pedagogical literacy which she defines as "the fundamental competence of being able to read, understand and criticise the documents that make up the professional knowledge base of teaching and learning". The focus here is on the processes by which teachers can become pedagogically literate, i.e. able to reflect on why certain practices may or may not *work*, and who ensure that their classroom practice is informed by specialist knowledge about pedagogy. This objective is echoed in Cajkler and Wood's proposal of pedagogic literacy as "a holistic vision of how teachers evolve through continuing and supported professional engagement with theory and practice, action and reflection" (2016, p. 517). Applied to the context of cooperative learning in higher education, such an approach would address Hermann's concerns about lack of depth in evaluating cooperative structures, allowing for deeper understanding of cooperative processes, e.g. how they can be linked to assessment criteria. The "role and impact of the teacher" in the successful implementation of cooperative learning is undoubtedly dependent on successful acquisition and maintenance of pedagogical literacy (2013, p. 183). This fits with Gibbs and Coffey's (2004) findings on the positive effects of university teacher training. They found that teachers who received pedagogical support were more likely to improve student learning, while teachers without support made an insignificant or even negative impact. Examples of ongoing pedagogical support for university teachers identified in this study included opportunities to discuss student feedback, access to conferences, mentoring within departments, and rewards for outstanding teaching.

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However, particularly in the context of cooperative learning in higher education, there are clear reasons for extending the notion of pedagogical literacy to students themselves. Päuler-Kuppinger notes that student-centred teaching methods require preparation for students as well as educators, particularly where students' beliefs about pedagogy differ from those of their teachers (2017). If, as Hermann (2013) argues, the success or otherwise of cooperative activities such as the jigsaw technique depends on students' existing conceptions of teaching and learning, it follows that students need to be involved much more proactively in pedagogical processes, for example through opportunities to discuss their beliefs about learning, and to gain insights into the pedagogical principles which underlie the cooperative approaches selected by their teachers. This is also in line with the recommendation by García-Almeida and Cabrera-Nuez that students' "subjective perception of learning" should be taken into account, given that students' self-efficacy and sense of control have been found to be key factors "facing knowledge construction in academic jigsaws" (2020, p. 88). It is clear, then, that the pedagogical literacies of students are equally deserving of investigation as those of teaching staff. This provided a basis for the research design of the present study.

The study aims to investigate the following two research questions:

1. What is the impact of the jigsaw technique on pedagogical literacies for students across a range of disciplines?
2. To what extent can the use of the jigsaw technique contribute to the development of pedagogical literacies for teaching staff?

Methodology

Because the focus was on observing practical issues of session delivery with the expectation that the study would itself effect change for the participants, action research was chosen as the most appropriate methodological framework (Denscombe 2010). The research team consisted of three experienced practitioners of cooperative learning methods including the

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jigsaw technique. This meant that each researcher was, in effect, a *practitioner-researcher* or *insider*. Norton (2009) discusses the methodological issues raised by this dual role within action research, most notably that findings may not be generalisable since the *practitioner-researcher* is likely to bring pre-formed beliefs to the study. In the present study, these beliefs could include assumptions about the value of cooperative methods, and about the importance of reflection in teaching and learning. These possible limitations are, however, counterbalanced by the specific benefits of insider action research when applied in higher education, most notably its ability to bridge the gap between educational theory and practice (Zuber-Skerritt 1992). Existing studies in the higher education literature confirm its value in the investigation of collaborative learning (e.g. Spruin & Abbott 2017).

In line with a framework designed for organizational settings, the initial "constructing" stage involved articulating the theoretical foundation of action and matching this to practical issues (Coghlan & Brannick 2010, p. 9). In this case, the Anglia Ruskin University's Active Curriculum initiative (ARU Students' Union 2017) had already provided a theoretical foundation with a specific focus on pedagogical literacy. For students, pedagogical literacy was defined as "the capacity […] to develop insights into pedagogic practices […] as well as gaining insights into their own learning strategies", whereas, for staff, it involved the ability to draw on and integrate into their teaching and pedagogical approach both best practice in the sector and examples of pedagogic research relating to teaching in higher education.

To investigate this in practice across the University as a whole, five observation cycles were set up with lecturers from the full range of academic disciplines: Arts, Humanities and Social Sciences; Business and Law; Health, Education, Medicine and Social Care; Science and Engineering. The fifth cycle was conducted with a University Librarian involved in the delivery of training sessions. A total of 83 students participated in the observed sessions. Ethical

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clearance for all participants was obtained in accordance with the University's ethics procedures.

Based on the three subsequent steps in Coghlan and Brannick's (2010) action research procedure, each observation cycle had the following structure:

Planning Action	(i)	Semi-structured pre-session interviews were conducted individually with the five staff participants, to explore awareness of jigsaw technique, and discuss how it could be applied in specific disciplines.
	(ii)	Support was provided for each staff member, where requested, in designing one teaching session using the jigsaw technique.
Taking Action		Each jigsaw session was observed by a member of the research team. Notes were recorded on an observation proforma, divided into jigsaw steps as described by Darnon et al. (2012).
Evaluating Action	(i)	After each session, students completed a questionnaire comprising Likert scales and free comments. The two final free-text questions were designed to evaluate the use of technique. The questionnaires were because of potential benefits in terms of reliability and validity (Burke et al. 2005).
	(ii)	Participant lecturers provided post-session reflections by completing a short written questionnaire.

A wide range of session topics was observed during the five cycles, including: a crime scene scenario in which students developed forensic and investigative strategies; a consultancy simulation on marketing strategies for Debenhams, the large department store chain; the development of a multi-faceted care

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plan for a patient with Parkinson's disease; the discussion of four key case studies in preparation for an essay on social theory; and training for library staff members for the role of the learning technologist using storyboard software. In each case, participants had opportunities to become experts in their allocated segment before sharing their expertise as per the steps of the jigsaw technique described above (see Background, p. 2).

The student feedback questionnaire consisted of 7 items as follows: the first section contained four statements which students were invited to rate on a Likert scale from 1 ('strongly disagree') to 5 ('strongly agree'), with a fifth statement asking students to state what percentage of a whole module they would prefer to be delivered in jigsaw format, with 5 Likert options: 100%; 70-75%; 50%; 20-25% and 0%. Each of these items offered the option of free-text comments. Two final open questions elicited further free-text comments on the pedagogical advantages and disadvantages of the format.

The reflective questionnaires for staff participants consisted of two sections. In the first section, staff were asked to rate three reflective statements, with responses expressed on a Likert scale from 1 ('strongly disagree') to 5 ('strongly agree'), followed by optional free-text comments, as above. The statements were designed to elicit perceptions of pedagogical advantages and disadvantages in a similar way to the student questionnaire. The second section, which focused on possible future development, contained an open question on how the staff participant might adapt their jigsaw activity if using it again. This allowed for evaluation of action, as per the action research cycle outlined above.

The responses to the open questions from the student questionnaires were coded manually, with sections of text allocated to two overall categories, in a similar approach to that employed by Herrmann (2013, pp. 180-1). However, while Hermann categorised perceptions as "positive" or "negative" (p. 180), in

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the present study, students' comments were allocated to the overall categories *pedagogical advantage* and *pedagogical disadvantage* and, within these two categories, emerging themes and descriptions were generated (Creswell & Creswell, 2018). The number of respondents for each theme was then counted so that its importance in the data could be evaluated. Pedagogical advantage themes which emerged from the qualitative data from students included: cooperation; engagement; real-world value'; and efficiency. Themes for pedagogical disadvantages included: logistics; group issues; unequal participation; concerns about information; and difficulties with interaction. The free comments and interview transcripts, i.e. all the qualitative elements in the data from staff, were also coded and allocated to the same overall categories. To allow direct comparison between emerging themes in the student and staff responses, comments from the staff data were checked against the themes from the student data to see if they could be matched. Where they could not, new themes were generated.

Results and discussion

Table 1 shows the results from the Likert scale questionnaire items for students and staff. With a total of 91.6% of student participants either agreeing or strongly agreeing that the jigsaw activity had helped them to learn about the topic, and 85.6% that the activity had encouraged all students to get involved, the overall positive response is very clear. This positive response from students was consistently corroborated in the observation notes on participation across the five sessions, e.g. "talk is animated"; "very much on task"; "all groups on task, talking through worksheet".

The free comments attached to these responses revealed the students' awareness not only of pedagogical practice, but also of their own individual learning needs. For example, one comment identified the benefits of "the technique of learning, as I work better in groups". Others focused on time-

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efficiency, the illustration of theory through practical examples, and the application of learning "in a way which helps information retention". There was also evidence to support Benton's (2016) findings concerning individual accountability. This was seen in comments that the activity had made participants "more responsible for what is going on in group". Several responses also expressed positive views of the interdependence associated with jigsaw activities e.g. "all elements were required, therefore everyone participated" and the observation notes provided further evidence: e.g. "students clearly listening to individual group members"; "groups clearly sharing ideas and working together". These latter points provide support for the previous students' comments on interdependence during the activity.

Table 1: Student and staff Likert scale responses

Student responses (N=83)	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The jigsaw activity helped me to learn about the topic	3 (3.6%)	1 (1.2%)	3 (3.6%)	33 (39.8%)	43 (51.8%)
The jigsaw activity encouraged all students to get involved in the session	2 (2.4%)	3 (3.6%)	7 (8.4%)	32 (38.6%)	39 (47.0%)
The jigsaw activity helped me to develop confidence in expressing my ideas	3 (3.6%)	2 (2.4%)	19 (22.9%)	41 (49.4%)	18 (21.7%)
Generally, I would rather learn directly from a lecturer than from other students.	4 (4.8%)	18 (21.7%)	40 (48.2%)	15 (18.1%)	6 (7.2%)

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Staff responses (N=5)	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The jigsaw activity helped students to engage with the topic	0	0	0	1 (20%)	4 (80%)
The jigsaw activity meant that students worked with peers they wouldn't normally work with	0	0	0	2 (40%)	3 (60%)
I would use jigsaw-style activities again in the future.	0	0	0	0	5 (100%)

Although 71.1% of students agreed or strongly agreed that the activity had helped them develop confidence, the greater proportion of 'neither agree nor disagree' responses on this item (22.9%) points to the complexity and individual variation in perceptions of cooperative learning noted by Hermann (2013). Some individuals commented that the technique had enabled them to contribute to group discussion when they normally would not, or that hearing others' views had allowed them to develop new opinions which they otherwise would not have considered. Negative views of the technique focused on difficulties with interpersonal dynamics, for example with group members who "do not want to listen". Here again, the students' perceptions were corroborated in the observation notes: e.g. "engagement balanced overall but one student still silent"; "one student seems less confident, goes off task". These comments reflect the overall pattern of the students' responses, i.e. that the majority of participants were able to contribute confidently, but some individuals experienced difficulties with group interaction.

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Student participants' views on student- versus lecturer-centred learning were also complex. The dominant 'neither disagree nor disagree' response (48.2%) may express a neutral stance towards delivery modes in general. However, analysis of the comments on this item confirmed the perception that "learning from both is needed", i.e. a preference for balance in delivery. Furthermore, this balance of student- and teacher-centred approaches is more likely to meet the needs of a wider range of students (Giles et al. 2006), and therefore be more inclusive. The students who felt uncomfortable with learning from their peers expressed this feeling in terms of individual learning preferences e.g. "would rather independent learn".

There was also evidence of awareness of specific pedagogical practices employed by lecturers during the jigsaw activity, with one participant noting the lecturer's role as facilitator moving between groups "to guide, encourage, keep us on track and summarise disjointed thoughts". This was also confirmed in the observation notes: e.g. "lecturer leaning in and eliciting participation from whole group"; "lecturer monitors unobtrusively" and is in line with previous findings concerning the role of "moderator" rather than "information-giver" (McLean & Attardi *in press*, p. 10). Individual accountability of participants was also in focus, but this time as a potential drawback of the technique, which, as one student participant put it, "lives and dies with the amount of effort a student puts into it".

The fifth item, which asked students to select their preferred frequency of jigsaw activities in a module, elicited a similar range of responses, with more than one third of students choosing the 50% option, and only two respondents each expressing a preference for the extreme options of 100% or 0% frequency of jigsaw activities in a given module. This would support Cavanagh's (2011) finding that students prefer a combination of approaches. Several responses mentioned the need to match pedagogical approach with subject content, e.g. for certain topics in bioscience to be "taught directly", but jigsaw-style tasks were felt to be "more efficient" for core topics.

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The reflective questionnaire responses from staff indicated a strongly positive response to the technique with all participants either agreeing or strongly agreeing with the statements on perceived student engagement with the topic, and on cooperation. The small sample size limits quantitative comparison, but the slightly different composition of responses to the question on cooperation, with one fewer staff participant expressing strong agreement, suggests awareness of limitations of the technique in terms of cooperation between students. This would correspond to the students' responses discussed above.

Overall, staff questionnaire responses had a higher level of agreement with the statements than those of students. This is perhaps unsurprising, given previous findings that teachers are more likely to favour student-centred methods (Päuler-Kuppinger & Jucks 2017). Moreover, the fact that staff participants had volunteered for the project as a way of developing active learning experience makes it much more likely that they would respond favourably to such methods. Stead (2005) notes a similar sample selection bias in responses to teaching questionnaires. A more nuanced picture of staff perceptions emerges from the coded qualitative data analysed below.

Themes from qualitative data

The coded qualitative responses from both students and staff are presented in Table 2 and analysis of the comments on pedagogical advantages leads to two key findings. Firstly, the overall positive response identified from the Likert scales was confirmed, with clear majorities of students and staff identifying pedagogical advantages in their comments. Secondly, there was coherence between student and staff responses: the three most frequently identified advantages were the same.

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Table 2: Themes from coded qualitative data

	Theme	**Description**	**Examples** (*staff comments in italics*)	**Students** (total=83)	**Staff** (total=5)
Pedagogical advantages	Cooperation	The session helped students to be more involved / work more closely together	I liked how it made everyone participate Everyone got involved *The opportunity to work with others* *This is a good way to facilitate collaboration*	49	4
	Engagement	The session was engaging / stimulating	It allowed me to engage further than a usual lecture A lot more fun than just sitting and taking notes *Students really engaged with both sets of discussions* *Intellectually stimulating for students*	21	4
	Real-world value	Benefits of practising real-world skills / applying knowledge in practice	Similar to what I expect to do in the future working in the field Preparing us better for real situations *They get it better when we apply it* *Help them with those employability skills*	20	5
	Efficiency	Learning was quicker / more efficient in this format	More done in less time *Completed the task more quickly than they would alone*	17	2
	Ease of use	Technique is easy for students to understand	*It's easy… for students*	0	2

	Theme	**Description**	**Examples** (*staff comments in italics*)	**Students** (total=83)	**Staff** (total=5)
Pedagogical disadvantages	Logistics	Challenges related to timings / room space	Use a bigger area More space *I will allow more time for the second part* *It's much more difficult for me, as a facilitator, to walk round the groups in a lecture theatre*	10	4
	Group issues	Issues with the size or composition of jigsaw groups	Better if the groups were smaller The groups were too big *It was important that the students did not choose jigsaw groups*	9	2
	Unequal participation	Some group members participating more than others / 'free-riding'	Not everyone actively participated Not everyone got fully involved and would rely on others	9	0
	Concerns about information	Incorrect or insufficient information from peers	The knowledge shared might not be accurate I haven't gained as much information as what I would have in a lecture / seminar *I think a small group of students feel that if something isn't given as a lecture, it's not much value*	7	1
	Difficulties with interaction	Awkwardness or anxiety when working with peers	Quite awkward talking to people you don't socialise with *Initially there's too much social anxiety*	7	5

Cooperation clearly emerged as the dominant pedagogical advantage of the technique as perceived by students, with 49 out of the 83 student participants mentioning the benefits of working together with others. There were several mentions of the fact that the jigsaw format had allowed participants to work not only with friends but with peers with whom they had not worked with before. This was summed up in one student's view that they had interacted "with different members of the class yet still with someone we know". This may be a key benefit of the jigsaw technique compared to more traditional group work, particularly if the students are allowed to work with friends in their expert groups where they build confidence before expanding their circle of connections in the jigsaw groups.

Enhanced collaboration was also picked up in the observer's notes. In several sessions there was a noticeable difference in interaction once the students returned to their jigsaw groups, with students seeming to engage more intently with peers in the final jigsaw step e.g. "noticeable during discussion that students listening to what others say". The reasons for this seem likely to lie in the jigsaw regrouping, which provides a more reliable structure than group discussion alone. In the words of one student respondent, the technique provided opportunities to "hear others thoughts, views and findings". It should be noted that in this study that contrary to the recommendations of Clinton and Kelly (*in press*), students were not previously briefed on the possible benefits of cooperative group work before the intervention, nor were their perceptions of the technique measured before the intervention. However, the frequency of comments suggests that the intervention had allowed students to reflect in depth on pedagogical issues. Staff comments followed a similar pattern, with all but one of the participants commenting on enhanced collaboration as a result of the technique.

The next three themes also showed a mirroring between student and staff comments. Engagement was noted as a key pedagogical advantage, reinforcing the questionnaire responses mentioned above. For the staff, the

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real-world value of the tasks was most frequently mentioned; a theme which ran through several of the interviews and indeed the session design, where students were often explicitly assigned to a professional role e.g. as CSI investigators, marketing strategists or writers of nursing care plans. Staff clearly also perceived the applied tasks not only in terms of transferable skills for the workplace, but also as a means to understand theory e.g. "they get it better when we apply it". Although this was not the most frequent advantage noted by students, the capacity to relate pedagogical approaches to real-world or professional skills was evident both in terms of directly transferable skills e.g. "something similar to what I expect to do when working in the field", and as a means of "applying social theories to real-life examples". These relatively frequent comments suggest that the jigsaw technique may be able to address the need identified by Burke et al. "for methodologies that are explicit in communicating the skills agenda" (2005, p. 141).

A final pedagogical advantage perceived by staff was that the technique is easy to use. Interestingly, none of the students mentioned this as a benefit. This might suggest that more support may be needed for students before implementation of the technique, perhaps with small-scale 'trial runs' before full jigsaw sessions, or more extensive explanations of the group steps which could include Clinton and Kelly's (*in press*) suggested briefing on pedagogical benefits mentioned above. This would, in effect, represent a sharing of pedagogical literacies between students and staff to the potential benefit of both.

In terms of pedagogical disadvantages, two key findings were evident. These were that the frequency of comments was lower on disadvantages than on advantages for both groups, and that the thematic coherence between the groups was less clear for the pedagogical disadvantages than for the advantages. Regarding the disadvantages, logistical concerns were mentioned by all staff, and were also the most frequent concern for students. Furthermore, both groups reflected on the need for more time, suggesting

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that practice may be needed for students and staff in order to optimise pedagogical benefits. However, in contrast to Herrmann's unexpected finding that students not participating equally was "hardly present in the data" (2013, p. 182), unequal participation was one of the most frequent concerns for students in this study. Staff seemed less aware of this, or perhaps less comfortable reporting it due to the "halo" effect. As they were voluntary participants who were also delivering the sessions, enthusiasm may have had an impact on their reflections (Deeley 2010, p. 51). As already discussed, small numbers of students felt uncomfortable interacting with people that they did not know, which may be perceived by peers as a lack of willingness to contribute. Specific interventions are needed, particularly for those who may have specific learning disabilities which affect their interaction, to help them engage fully with the learning process. This could include participating in written form, perhaps through a learning app, to avoid the need for face-to-face interaction. Furthermore, one of the staff participants has, since this intervention, been able to set up a mentoring scheme for jigsaw tasks, in which those who have already experienced sessions brief their peers in subsequent cohorts on how to make the most of jigsaw activities. This seems an effective way to address this area and to also further enhance pedagogical literacies for student participants.

A key factor which is not always present in existing studies of the jigsaw technique is students' perception that jigsaw activities may expose them to incorrect information from peers. In this study, particularly post-intervention, participants were less likely to consider potential drawbacks of student-centred methods. However, the staff interview transcripts revealed a more nuanced picture, with two participants mentioning the importance of including an element of traditional lecturing e.g. "I think we need to have some time together to pull together the work that's done". This was reflected in the session design because it was noticeable that all staff chose to include a plenary stage after the jigsaw to draw together key strands and respond to queries with the whole class, even if students' attention was not always

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drawn to this explicitly. Emphasising in the pre-session explanation that a teacher-led plenary will be provided might be one way to address some students' concerns.

Conclusion

The findings of this study indicate that the jigsaw technique has considerable benefits for the development of pedagogical literacies across a range of disciplines, particularly in terms of student cooperation and engagement. There is evidence not only of students' engagement with the topic of study, but also of reflection on the conditions which are most likely to facilitate their own learning and acquisition of real-world skills. This clearly points to the usefulness of the technique in helping students to develop pedagogical literacies. These benefits are echoed in the findings from the staff participants. It is therefore argued that higher education practitioners in diverse disciplines should make increased use of the jigsaw technique. Those interested in trying out jigsaw activities will find that ABLConnect (2020) offers a useful overview of the technique as applied in higher education, and Aronson & Patnoe (2011) provides an accessible guide to the underlying principles. When the technique is implemented, students should be given opportunities to engage in meaningful discussion of its benefits, before and after their involvement. In this way, students and staff can co-create an enriched learning experience for all participants.

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