RESEARCH REPORT

Assessing engagement with construction-based, structured-play activities designed for the teaching and learning of the language of metacognition in a primary Pupil Referral Unit

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Abstract

Background and purpose: I conducted a case study at a primary pupil-referral-unit (PRU), exploring the use of construction-based, structured-play activities for the teaching and learning of the language of metacognition (LoM). Metacognition is important for developing independent learners and, in the context of a PRU, for both assisting students in obtaining academic outcomes similar to their mainstream counterparts and facilitating reintegration into mainstream settings.

Aims: Engagement is a necessary pre-requisite for teaching and learning to occur, and in this report, I explore primary-PRU students' engagement with the activities to determine if the activities are sufficiently engaging such that they can unfold in a manner consistent with their design.

Study design or methodology: Three students at a primary PRU in the South-East of England participated in eight sessions of two construction-based, structured-play activities; both activities included 'metacognition resources' of my own design, which were intended to introduce students to the LoM. To explore engagement with these activities, context-specific indicators were obtained from observation of video and audio data, and a 'Leuven-inspired' scale of engagement, ranging from 1 (very low) to 5 (very high) was constructed and used to monitor engagement throughout the sessions.

Findings: Considering the context and the archetypal PRU student, the activities were generally engaging. I found students to be sufficiently engaged such that the activities could unfold in a manner consistent with their design. The build process was, however, generally more engaging than the 'metacognition elements' of the activities.

Implications for practice: The findings suggest that construction-based, structured play and the metacognition resources offer a viable means to engage students with metacognition. Such activities may provide a way to help students in PRUs develop independency in learning, facilitate their reintegration into mainstream settings, and improve their academic outcomes.

Keywords: pupil referral unit; alternative provision; metacognition; self-regulated learning; engagement

Context

I conducted a case study at a primary pupil-referral-unit (PRU), exploring the use of construction-based, structured-play activities for the teaching and learning of the language of metacognition (LoM). I analysed verbal and non-verbal indicators, and the artefacts generated by students while conducting the activities, to explore two aspects of the activities relating to the viability of their use in alternative provision classrooms: their structure and function, and engagement. It is the latter aspect – engagement with the activities – that is the subject of this research report.

Students are expected to be educated in a mainstream setting (Education and Skills Funding Agency, 2021); when this is not feasible – for example, due to exclusion, health or refusal –, students may receive education in an alternative provision setting, such as a PRU (Education and Skills Funding Agency, 2021). Students in such settings are more likely to be male, to have had negative educational experiences and behavioural issues, and, compared to their mainstream counterparts, are more likely to have special educational needs (SEN), an EHCP, to be disengaged from education, and to have lower academic outcomes (Department for Education, 2021b, 2021a; Jalali & Morgan, 2018; Michael & Frederickson, 2013; Strand & Fletcher, 2014; Tate & Greatbatch, 2017; Timpson, 2019). Despite the challenges present in PRUs, they are pressed to deliver academic outcomes similar to mainstream settings (Department for Education, 2013, 2018; OfSTED, 2016), and to facilitate students' reintegration into mainstream settings where feasible (Department for Education, 2018).

PRUs and their students are often neglected in terms of policy, practice and research (e.g., House of Commons Education Committee, 2018). I have found it difficult to discover previous examples of construction-based, play activities as the subject of research in PRU settings. This case study was intended to contribute to redressing this neglect of such settings by communicating my exploration of (some aspects) of the viability of construction-based play for teaching and learning metacognition, which may inform my own practice and, perhaps, contribute to the practice of others.

The focus of the activities is metacognition, considered here a component of SRL. The activities were designed with the intention of introducing students to the LoM, through a process in which educators and students can co-construct the language, and to begin to do so through meaningful and accessible contexts (Chatzipanteli et al., 2014; Roebers, 2017; Tarrant & Holt, 2016; Whitebread & Pino-Pasternak, 2013). I believe that assisting students in developing SRL will move those students towards independency in learning, a worthwhile endeavour in and of itself; however, this process would also improve their academic outcomes and facilitate their reintegration into mainstream settings (e.g., Dobber et al., 2017; McClelland & Cameron, 2011; Pillay et al., 2013; Rice et al., 2015).

The meaningful and accessible context consisted of construction-based, structured-play activities. The benefits such play activities afford are numerous, but I shall consider four of the most pertinent, here. First, learning and practice are important and salient examples of the function of play (Baldwin et al., 1993; Chu & Schulz, 2020; Schulz, 2012; Schulz et al., 2007). Second, I have found from experience that construction-based activities are both motivating and engaging. Third, it affords opportunities for students to participate in metacognitive processes and to employ metacognitive knowledge (Bryce & Whitebread, 2012; Chatzipanteli et al., 2014; Whitebread, 2010; Whitebread et al., 2009). Fourth, as construction-based play entails the use of manipulatives, there is an outward expression of students' metacognitive experiences for teachers to observe (Bryce & Whitebread, 2012; Krajcik & Shin, 2014; Whitebread et al., 2009). Each construction activity included

'metacognition resources' of my own design to facilitate access to, and development of, the LoM. These activities are considered in more detail in *Inquiry plan and activities*.

Motivation, focus and questions

Students in PRU settings are often disengaged from education. As engagement is a necessary pre-requisite for any teaching and learning to occur (e.g., Appleton et al., 2006; Greenwood et al., 2002; Reeve & Tseng, 2011), a first hurdle necessary to overcome is to engage students.

Engagement is closely entwined with both motivation and SRL (and, by extension, metacognition) (Cleary & Zimmerman, 2012; Guthrie et al., 2004). Fredricks et al. (2019) summarises the distinction between engagement and motivation: motivation "refers to the underlying sources of energy, purpose, and durability, whereas engagement refers to their visible manifestation" (p. 22); both engagement and disaffection are, at least partially, contingent upon motivation (Skinner et al., 2009). However, it is necessary to recognise that motivation is "necessary, but not sufficient for engagement" (Appleton et al., 2006, p. 428): the source of energy is there, but engagement requires a 'channelling' of that energy into task-appropriate action. SRL consists of a battery of self-directed acts, and, as engagement is the 'acting', or the 'process of investment' in an activity, the connection is apparent (Cleary & Zimmerman, 2012): engagement facilitates the development of SRL knowledge and skills, and SRL knowledge and skills provide a competency to engage.

Thus, it is worthwhile exploring student engagement with classroom activities: to establish if they are sufficiently engaging, what elements are engaging, and what improvements can be made to the activities to promote engagement. The activities that were the subject of this case study were designed to both motivate students and direct that energy into the teaching and learning of the LoM. In this report, I have elected to focus on engagement; whether the construction activities are suitably designed for the teaching and learning of metacognition *beyond engagement* is not addressed, here. As the focus is on the indicators of engagement, the research question that emerges is:

> Are there indicators of engagement with the construction-based, structured play activities, including those elements of the activities designed for the teaching and learning of the LoM?

Inquiry plan and activities

The case consisted of a group of three KS2 students (between 9 and 11 years old) – Rupert, Charles and Peter (pseudonyms) –, assigned male at birth, in a primary PRU in the South-East of England, participating in two construction-based, structured play activities across eight, one-hour sessions, facilitated by me. Each session was video recorded using a single camera, and audio was recorded using a microphone.

There were two activities: a Lego-set-construction activity, and a marble-run-construction activity, both selected as I considered them meaningful, appropriate and engaging for students, all necessary for teaching and learning metacognition (Chatzipanteli et al., 2014; Roebers, 2017; Whitebread et al., 2009). Both activities were designed for individual participation, but students were free to collaborate. I set the order for the activities, but the distribution of the activities across the eight sessions was determined by the students.

Each activity had four stages: three SRL stages of planning, performance control, and self-reflection, and a build-process stage[1]. The SRL-monitoring stage and the build-process stage had several 'phases' of no fixed-duration that are intercalated: students moved from a build-process phase to an SRL-monitoring 'phase' and back again throughout the activity, which is bracketed by an SRL-planning and an SRL-reviewing stage.

To support students with metacognition, I developed 'metacognition resources' to use during the activity. The metacognition resources provided guidance and structure to the metacognitive elements of the activity, and were designed to facilitate engagement in discussion regarding the language of metacognition. The resources consist of a 'metacognition board', 'metacognition keywords', and, for the Lego activity, 'SRL prompts'. The resources were intended to complement the construction activity, and some of the resources were designed to further integrate the metacognitive elements into the activity; the intention was to amalgamate the construction and metacognition elements so that the teaching and learning of metacognition was perceived as an intrinsic part of the activity (see Appendix A for further information on the activities).

The rationale behind the activity was as follows: students engage in a construction activity, and, in the process, have 'metacognitive experiences' – that is, they utilise metacognitive knowledge or skills in the pursuit of some task – the external manifestations of which the teacher may observe; later, students and teachers can co-(re)construct these experiences, understand them, and then attach meaning derived from these experiences to keywords or the connections between words. Through this process, the language of metacognition can begin to be constructed by students and teachers: the meanings, the multiple facets of meaning, and the web of relations of meaning.

To explore engagement, I adopted a four-dimensional model (Lawson & Lawson, 2013, p. 434), consisting of cognitive (cognitive processes as they relate to task execution), agentic (participation in shaping the learning experience), behavioural (actions, attention and effort as they relate to the learning experience) and emotional (affect, volitional or 'imposed', as it relates to the learning experience) dimensions (e.g., Appleton et al., 2006; Reeve, 2012). This seems to be a common model in the literature (Fredricks et al., 2019; Fredricks & McColskey, 2012; Reeve & Tseng, 2011).

I want from this conceptualisation the indicators of engagement – the contextualised signs: verbal, non-verbal, manipulation of materials, and generation of artefacts – that allow me to evaluate the activities. The engagement indicators for the four-dimensions were derived from numerous sources (e.g., Lee & Reeve, 2012; Philp & Duchesne, 2016); Table A1 provides examples of indicators for each dimension of engagement. Engagement was coded from observation, predominantly of video and audio data, and analysis of engagement was predominantly a deductive coding process, with alterations through inductive coding to translate the indicators for my context.

In addition, I employed a 'Leuven-inspired' scale of engagement, ranging from 1 (very low engagement) to 5 (very high engagement) informed by the engagement literature (Addessi et al., 2015; Custodero, 1998; Fawcett & Watson, 2016; Shapiro, 2011; Tordet et al., 2021), and shaped by my own experiences as a practitioner in a PRU. The aforementioned indicators were used to identify

1 I elected to use the terms planning, monitoring and reviewing for the SRL stages, as I believe these terms are more accessible to the students (to contrast these with metacognitive process of planning, monitoring and reviewing, I use SRL as a qualifier: e.g., 'SRL planning' – versus simply 'planning' – for metacognitive planning).

engagement, and assignment to levels was based on the nature and intensity of the indicators (see Table A2).[2]

Ethical considerations and relationships

The students were recruited through liaison with the head of the primary centre. Three students form a single class agreed to participate after a discussion with each student together with their parent/caregiver. The students were known to me, but I was not their usual classroom teacher. However, their usual teachers and teaching assistants were present, and the activities were conducted in their usual classroom; the setting was familiar to them, with very little alteration to their usual routines. The children appeared confident and relaxed, and expressed no uncertainty or unwillingness to participate.

Informed consent is important, and both parents/caregivers and student were included in a discussion about the activities and whether they desired to participate. Parents/caregivers gave written consent and students gave verbal consent in the presence of parents/caregivers. Parents/caregivers were provided with a booklet giving a detailed description of the study, and an information letter providing a more summarised description of the study.

Although details such as educational needs and students' individual abilities and preferences would all contribute to a better understanding and analysis of the activities, I have elected for ethical reasons to exclude reference to these details: the number of participants is too small to guarantee pseudonymity when considering all possible audiences, and the privacy of participants in this regard supersedes any benefits acquired through a consideration of students SEN.

I adhered to the BERA guidelines throughout the study, and to the requirements and expectations of the setting.

Findings

I shall consider each activity in the order in which they were conducted: the LEGO activity followed by the marble-run activity. For each activity, I use both indicators and levels of engagement. The SRL-planning and the SRL-reviewing stages each have their own section presenting the analysis; the analyses for each build process stage have been combined for inclusion in a single section, as have the analyses for each SRL-monitoring stage.

LEGO activity

This activity spanned three, approximately one-hour, sessions. Peter and Charles attended all three sessions; Rupert was not present for session two. Figure 1 (a and b) provide a visual representation of engagement across the different stages of the activity as the sessions progressed. See Figure B1 for an example of the activity unfolding.

[2] Note that engagement is a measure of engagement with the activity: low engagement does not necessarily mean 'disruptive', it could just mean 'doing something else'. The activities are intended to approximate play, and therefore students are encouraged to participate, but not 'commanded' to; as such, engagement is a measure of voluntary engagement: it measures the appeal of the activities.

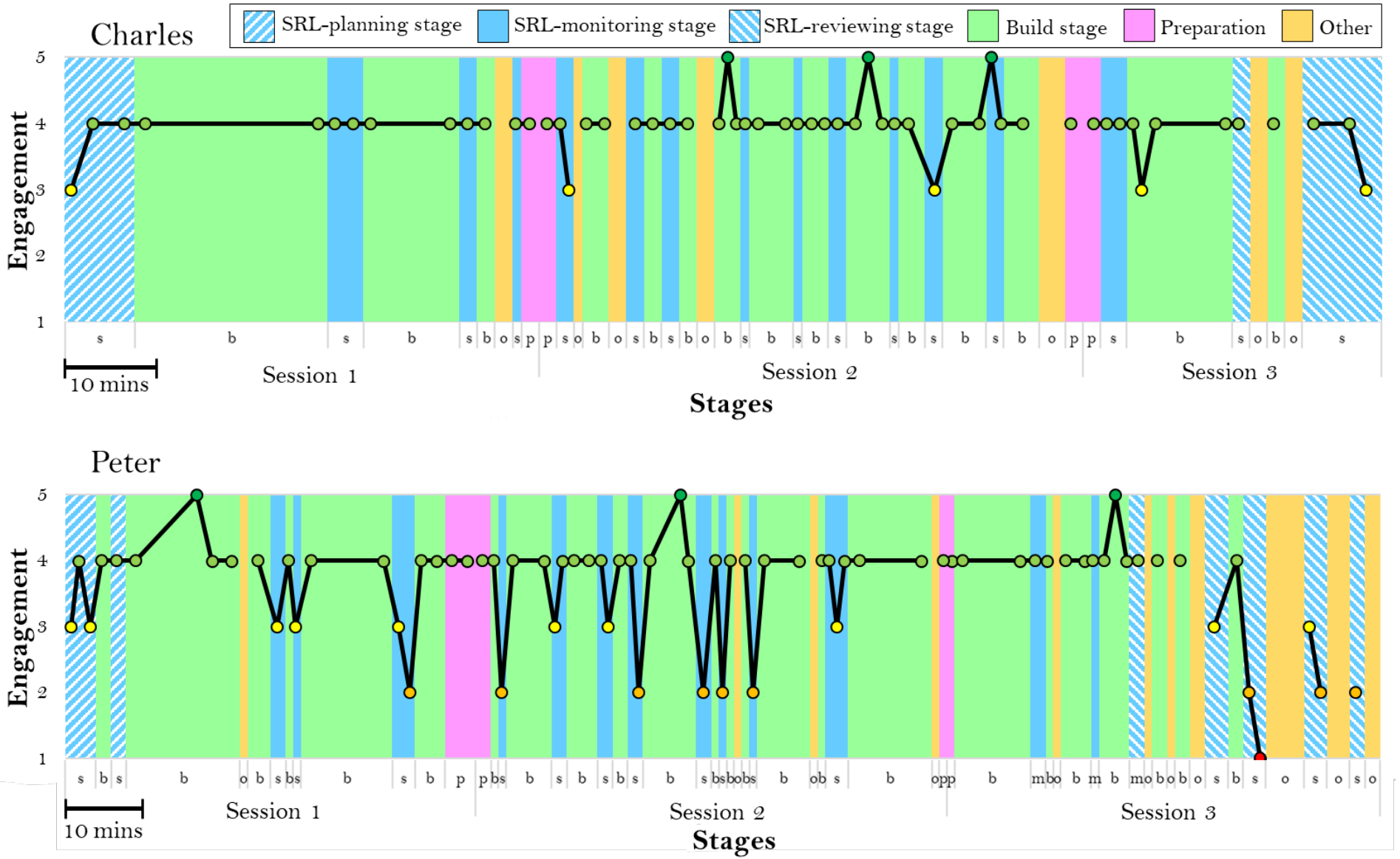

Figure 1a: Engagement levels across stages of the LEGO activity for Charles and Peter. See 1b for a description.

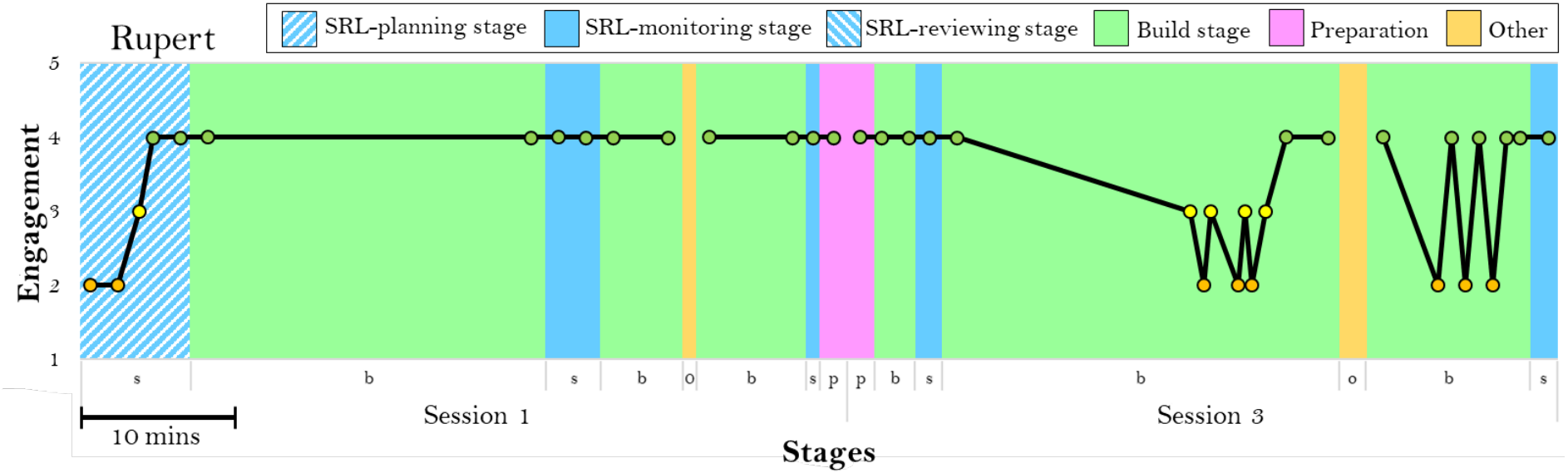

Figure 1b: Engagement levels across stages of the LEGO activity for Rupert. 'Preparation' refers to the organising, preparation and tidying of activity resources; metacognition indicators from this stage were assigned to the most appropriate stage, usually SRL planning. 'Other' refers to events outside of the activity that constitute an acceptable diversion (e.g., staff speaking to students about unrelated classwork).

LEGO SRL-Planning stage

Each student had their workstation set-up with their own metacognition resources and LEGO sets. I first provided an overview of the activities and the metacognitive resources. Students then proceeded to create their plan, and we considered a metacognitive keyword for this stage: *Making plans*.

While setting up the boards, Charles' and Peter's engagement (level 3) was little more than compliance: they appeared unenthusiastic – languid in their movement –; actions were perfunctory as they followed guidance. Rupert was not participating: slouched in his chair, arms folded, whilst a teaching assistant set-up his metacognition board (level 2).

When set the independent task of organising the build-stage images, engagement generally increased. All three students demonstrated cognitive and behavioural engagement: diligently locating and ordering the images, engrossed in their own activities; there was a constant shift in gaze between images, and momentary pauses to survey the ordering. As a result, engagement moves from level two to three to four for Rupert – from cursory interaction to compliance to active involvement –, and three to four for Charles and Peter – from compliance to active involvement – (see Tables 3, and A3 for an extended table).

Table 3: LEGO activity: SRL-planning stage: Engagement levels with indicators

Level	Dimension	*Example*
4	Behavioural	*Charles and Peter are actively involved in arranging the build-stage images.*
3	Cognitive	*Charles and Peter are actively engaged in the task, but mechanically.*
2	Behavioural	*Rupert is not participating in the task.*

At the opening of the build process, students were eager to start constructing their LEGO models. LEGO pieces were selected, compared, positioned and re-positioned, rotated, and sometimes discarded. Students inspected the models – compared them to the build-stage images of the plan and to the instruction manual –, configured and re-configured, rotated, and sometimes partially dismantled them. Slowly, across the three sessions, the models took shape, and, at their conclusion, placed on display.

The build process retained a high level of engagement and kept possession of students' interest, as outlined in Tables 4 and A4. There was an enthusiasm combined with assiduousness. Students oriented themselves towards their own workstation, with their eye gaze focused on either the instruction booklet, the stockpile of pieces, or the evolving model; there is a constant sound of rummaging through containers of LEGO pieces. There was little talk between students – unusual for this otherwise communicative classroom –; the only talk was Charles (and occasionally Rupert) as he talked to himself or spoke to the room as a signal for assistance.

This stage was almost predominantly level four across the group, with some ebbs and flows between two and five, apparent in Figure 1. Charles, for example, occasionally becomes very animated and verbalises his enthusiasm, and occasionally highly focused, unresponsive to distraction

and only talking to the activity (level five, see figures 2 and 3 for examples of deductive coding). Generally, students resisted distraction. In session three, however, Peter had completed his model, and insisted on engaging Rupert in a conversation; although Rupert remained behaviourally and emotionally engaged, his cognitive engagement was disrupted by Peter's interruptions – consequently, his engagement oscillates between level two, three and four.

Table 4: LEGO activity: Build-process stage: Engagement levels with indicators

Level	Dimension	*Example*
5	Cognitive	*Talking to the activity.*
4	Emotional	*Students display enthusiasm – leaning forward, alert, and manipulating the resources in front of them.*

LEGO SRL-Monitoring stage(s)

SRL-monitoring stages were mostly initiated by the SRL-monitoring prompt in the instruction booklet, which instructs students to compare the model to the build-stage images; occasionally, I would approach students or address the class. The model was compared to the plan, then the student and I discussed their metacognitive experiences.

Charles and Rupert generally maintained a high level of engagement (level four); both offered considered responses to questions and reflected on their experiences during the build process. They shuffled through keywords, offering some for consideration, and maintaining their own opinions – not simply accepting mine. They did not display strong emotional indicators, but their cognitive and behavioural indicators established the level. See Tables 5 and A5 for engagement levels with indicators.

Peter's engagement was generally level three and two, with a noticeable difference compared to the build-process-stage engagement-levels. For Peter, each SRL-monitoring stage phase was an inconvenience, disturbing his build; he would sit, slouched, contributing to the discussion but with minimal investment in thought and actions (level three). At the lowest engagement (level two), anything was a worthy distraction: the model would be rolled in the hands, and he would frequently and momentarily turn away, giving spiritless responses that drifted off.

Table 5: LEGO activity: SRL-monitoring stage: Engagement levels with indicators

Level	Dimension	*Example*
5	Emotional	*Charles yells, "Monitoring! Tick! Tick! Tick!" and throws his hands up ('tick' being a reference to using a green tick to record a monitoring stage).*
4	Cognitive	*Charles and Rupert would maintain their own opinions, and not simply 'accept' the opinion of others. Suggests genuine deliberation.*
3	Cognitive	*Students mostly demonstrate appropriate thought and action, but the investment is minimal.*
2	Emotional	*Spiritless responses tend to drift off.*

LEGO SRL-Reviewing stage

As the build-process stage drew to a close, there was one final SRL prompt to support their work: SRL reviewing, which Peter and Charles reached separately[3]. There were three tasks: one final comparison of their model to the build-stage images, reviewing the SRL-planning and SRL-monitoring stages to make a final consideration of the keywords in those stages; and introducing keywords relating to the SRL-reviewing stage.

Charles and I engaged in an extended discussion, reflecting on his experiences during the activity, and surveying the collage of keywords on his metacognition board. Charles participates actively (level four) as we employ different props – the model, the instruction booklet, the keywords – to aid in the reconstruction of experiences and consider the meaning of the vocabulary. His engagement only waned (level three) as the discussion extended beyond four minutes.

Initially, Peter engaged in a discussion (level three), but this quickly deteriorated (level two and one) to vocables – "uh hum", "hmph" –, and he tended to avoid discussion. He would make little consideration of the placement of keywords, attaching them randomly to the board. His completed model became the focus of his attention, not a discussion on metacognition; as such, although we progressed through the same tasks as for Charles, it was much less productive. See Tables 6 and A6 for engagement levels with indicators.

Table 6: LEGO activity: SRL-reviewing stage: Engagement levels with indicators

Level	Dimension	*Example*
4	Cognitive	*Charles offers extended and meaningful responses to questions.*
3	Behavioural	*Charles is standing and fidgeting with the chair, but still contributing (signs of becoming restless).*
2	Cognitive	*Desultory responses to questions.*
1	Behavioural	*Restless, frequently orienting body away from workstation.*

Marble-run activity

The marble run spanned five, approximately one-hour sessions. Charles and Peter worked independently for the first two sessions (four and five), constructing individual models by following the provided plans. Rupert was present for lesson five, and similarly worked independently constructing a model following the provided plan; Rupert did not participate in session four. In session six, Charles and I collaborated in constructing a model of our own design; neither Peter nor Rupert participated (Peter elected not to, Rupert for unrelated reasons). In sessions seven and eight, Charles and Peter collaborated on a track of their own design. In session seven, Rupert continued with his track from session 5, following the plan; he was not present for session eight. Figure 4 shows the engagement level for each student as the activity unfolds. See Figure B2 for an example of the activity unfolding.

[3] Rupert was present for two of the three sessions and did not have an opportunity to participate in the SRL-reviewing stage. In subsequent sessions, he elected to move on to the marble-run activity with the other students, rather than continue with the LEGO model.

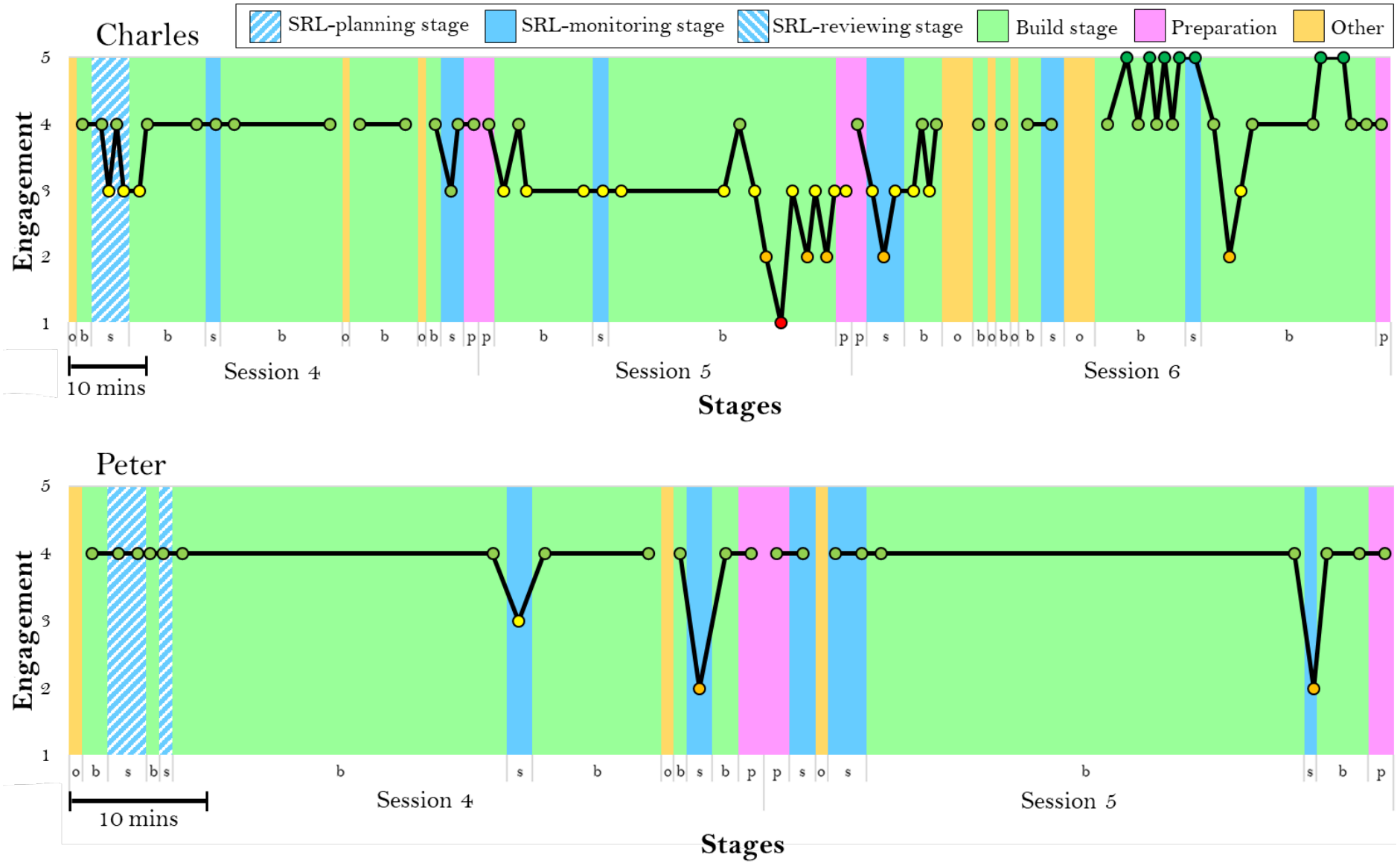

Figure 4a: Engagement levels across stages for marble-run-activity sessions 4-6 for Charles and 4 and 5 for Peter. See 4c for a description.

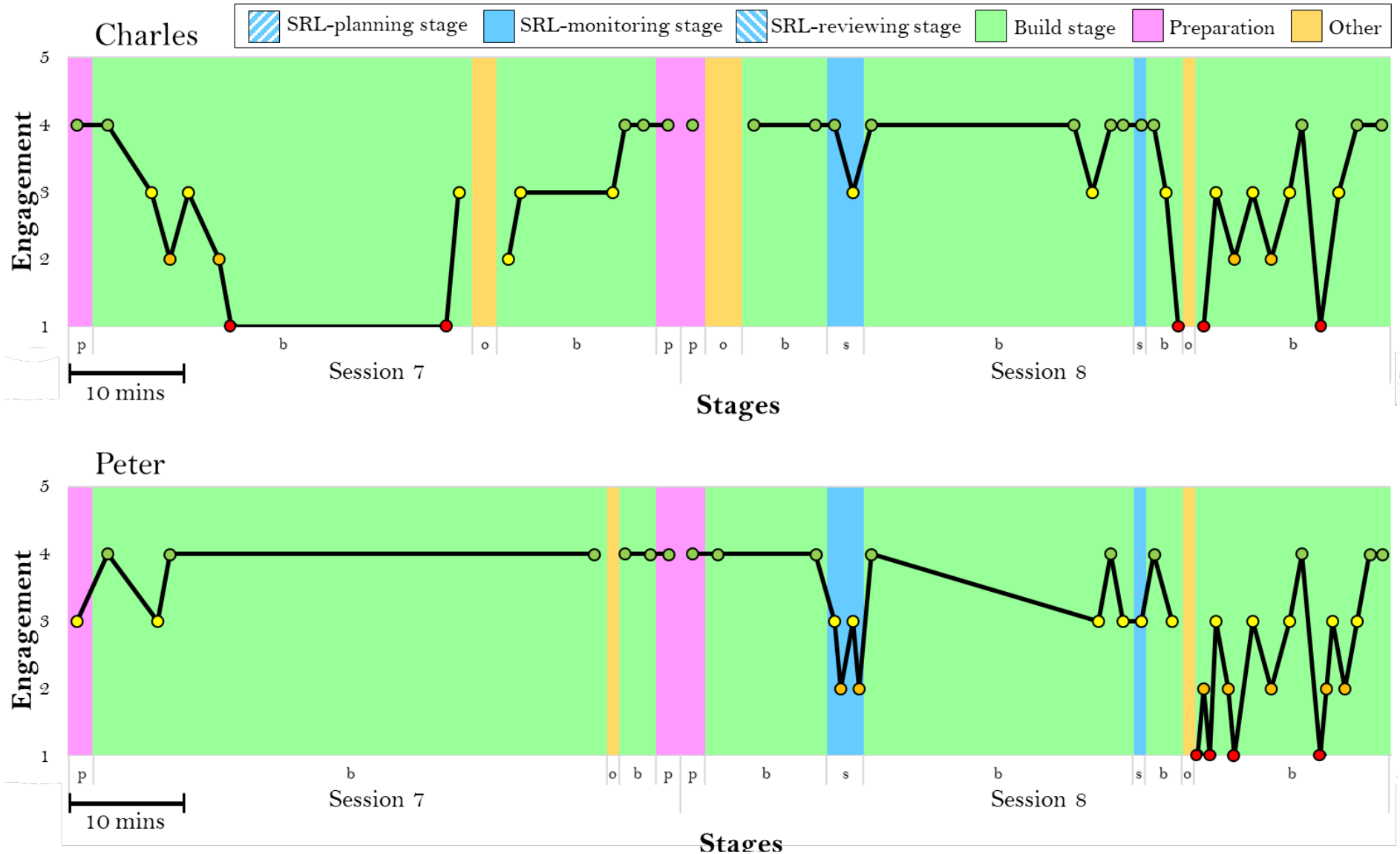

Figure 4b: Engagement levels across stages for marble-run-activity sessions 7 and 8, for Charles and Peter. See 4c for a description.

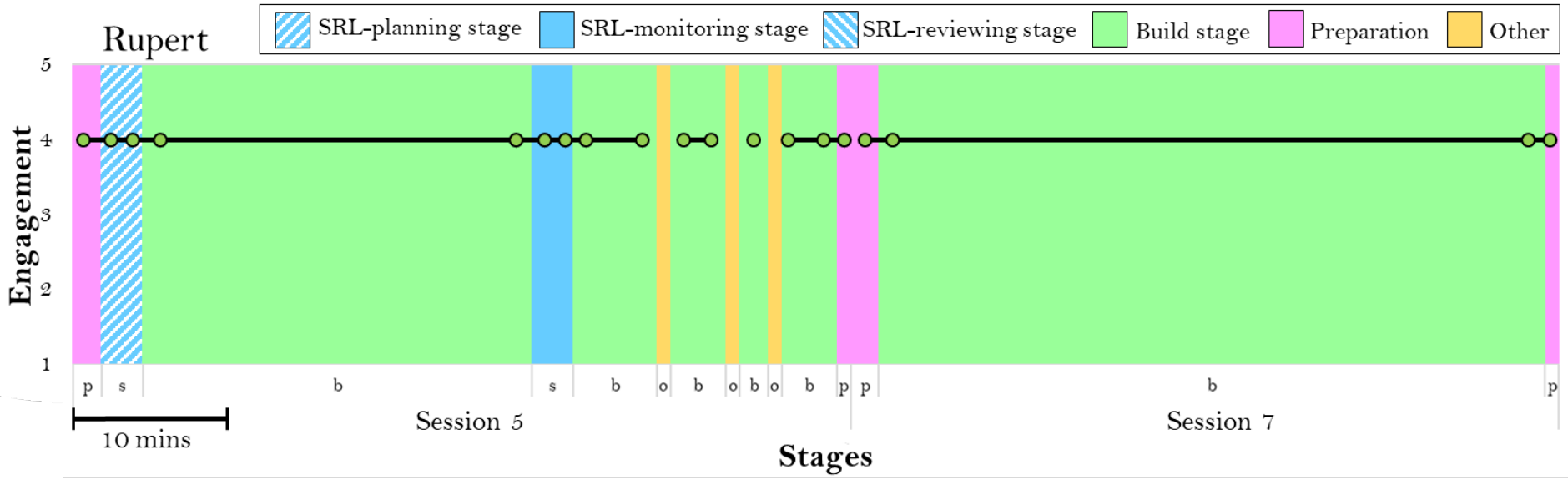

Figure 4c: Engagement levels across stages for marble-run-activity sessions 5 and 7, for Rupert. Preparation' refers to the organising, preparation and tidying of activity resources; metacognition indicators from this stage were assigned to the most appropriate stage, usually SRL planning. 'Other' refers to events outside of the activity that constitute an acceptable diversion (e.g., staff speaking to students about unrelated classwork).

Marble-run SRL-planning stage

Students, now familiar with setting up their workstations, proceeded to do so without prompting. They chose a marble run to build, created the plan on the metacognition board, and I introduced the *Making plans* keyword.

Peter (level four engagement), Rupert (level four) and Charles (oscillates between three and four) maintained focus as they busied themselves arranging the instructions in sequence and attaching them to the metacognition board. They remained at their respective stations, contending with the task at hand; Peter moved energetically around his. Rupert, in a sign of agentic engagement, began identifying keywords related to processes he believed he would be using in the build process. On the other hand, Charles' emotional expressions were largely non-descript; he had a cautious mien, which contributed to his straddling the border between levels three and four. See Tables 7 and A7 for engagement levels with indicators.

Table 7: Marble-run activity: SRL-planning stage: Engagement levels with indicators

Engagement		
Level	Dimension	*Example*
4	Cognitive	*Peter deduces and attends to important features of the instructions that assist in determining the correct sequence.*
3	Behavioural	*Charles perseveres, but there are instances of discouragement in which he requires support.*

Marble-run Build-process stage(s)

The students alternated between phases of the build-process stage and phases of the SRL-monitoring stage across all five sessions. Pieces were selected, joined, rotated, adjusted and sometimes discarded, and these components were assembled into sections, and these sections then combined to form an elaborate track. Slowly, over the sessions, the marble runs took shape, and, at their conclusion, were put into action.

There was a high level of engagement (level four): students were up and moving around their workstation, inspecting the plan, searching for pieces, busy assembling. There was more talk in this activity: students invited others to witness demonstrations of marbles winding through sections of their builds; each student's contraption was also a source of curiosity for the others, who wandered to each other's workstation to investigate. There were also indicators of agentic engagement as students endeavoured to expand the original designs with extensions of their own (see Tables 8 and A8 for engagement levels with indicators).

There were some deviations from level four, especially for Charles. In the second marble run session, for instance, his engagement dropped to three, and occasionally two and one, since, for reasons unknown, he was lacking the energy to confront the cognitive demands of the task, which caused a decline in emotional and behavioural engagement.

There was a noticeable decline in engagement (levels three, two and one) towards the end of the final session (eight). The activity had taken place for five sessions; enthusiasm was

waning, and this was compounded by unsuccessful trials. Although, even when Charles and Peter moved away from the activity – for example, engaging in symbolic play with spare pieces of the marble run, or using those spare pieces to construct something arbitrary –, they found their way back to test the track again, with engagement improving (level 4) with successful trials. This combination of frustration and gradual loss of enthusiasm, and the 'one last attempt' effect of the marble run activity, manifested itself in the mercurial engagement of students that shifts constantly between levels (one, two, three and four) at the end of session eightMarble-run SRL-

Table 8: Marble-run activity: Build-process stage: Engagement levels with indicators		
Level	Dimension	*Example*
5	Emotional	*High degree of positive affect: Charles is animated and verbalises his enthusiasm and enjoyment – "Jamie [myself]! Nah, this is going to be too good! Nah, Jamie! nah, nah, nah, Jamie! Jamie! That's going to be too good."*
4	Cognitive	*After testing, Charles makes sensible decisions about which parts of the track to adjust and how to adjust them.*
3	Behavioural	*Charles is seated at his station, but engaged in conversation with Peter.*
	Behavioural	*Charles is pacing about his workstation, waiting to begin.*
2	Behavioural	*Charles drifts about around his workstation. He picks up pieces only to put them back down again.*
1	Behavioural	*Charles slumps down, sits cross-legged, and puts his head in his lap.*

Monitoring stage(s)

There were no SRL prompts for this activity; rather, at opportune moments during the build-process stage, I engaged students in the SRL-monitoring stage, in which we discussed their metacognitive experiences during the build process and related them to the metacognition keywords.

Predominantly at level four, Charles and Rupert contributed to discussion by selecting keywords, attaching them to the metacognition board, and offering examples from the build process in pursuit of developing meaning of the metacognition keywords. Peter (straddling levels two and three), on the other hand, again resorted to vocables and monosyllabic responses – "mhmm", "yep" –, and, as with his completed LEGO model, the marble run became the focus of his attention – in the group build, he walked away from the discussion to continue modifying the track, leaving Charles and I to discuss the keywords.

Generally speaking, there was a slight downward shift in engagement level compared to the same stage for the LEGO activity, and the frequency of engagement also declined[4]. See Tables 9 and A9 for engagement levels with indicators.

Table 9: Marble-run activity: SRL-monitoring stage: Engagement levels with indicators		
Level	Dimension	*Example*
5	Emotional	*Charles is talkative with a cheerful, high-spirited tone.*
4	Cognitive	*Students would make considered contributions to task, in selecting keywords and in the discussion.*
3	Emotional	*Students show lack of colour or energy in responses.*
2	Cognitive	*Peter offers only vocable and monosyllabic responses – "yep", "mhmm" – to questions.*

Summary of findings

Learning is contingent upon engagement, and the activities would be ineffectual without it (e.g., Appleton et al., 2006; Greenwood et al., 2002; Reeve & Tseng, 2011). Engagement in the build process across both activities was, averaging for all four students and across all sessions, at level four, with students demonstrating cognitive, behavioural and emotional engagement, and occasionally agentic engagement. Engagement in the SRL stages was, for Charles, between level three and four, and, for Rupert, level four, with indicators of cognitive and behavioural engagement, but less pronounced indicators of emotional engagement; for Peter, it was between level two and three – with generally less positive indicators across dimensions.

Engagement with the build-process was routinely at level 4 or thereabouts, with students thus sufficiently engaged such that they were meaningfully participating and enthusiastic. These activities are not, however, deterministic in terms of engagement, and they do not exist in a vacuum: myriad factors – individual and contextual, inside and outside the classroom, during or before the commencement of the sessions – can positively or negatively affect engagement. But, generally speaking, the build process captured students' attention.

Engagement during the SRL stages was lower than for the build-process, and the metacognition resources were addenda to the build process, interaction with which declined in frequency as the sessions progressed; a trend compounded in the marble run activities by the lack of a metacognition prompt intercalated in the instructions: instead, I had to initiate discussion, which seemed less effective in maintaining their engagement. It is possible to see the detrimental effects this has to teaching and learning metacognition with Peter, whose engagement, on occasion, declined to the point where meaningful interaction with the metacognition resources was not possible. Although the metacognition resources – which are my original contribution to these activities – did not exhibit the same level of engagement as

[4] This section would be followed by a consideration of the SRL-reviewing stage, but there is no SRL-reviewing stage for the marble run activity: the time allocated to the activities came to an end before reviewing could occur.

the build process, they may be sufficiently engaging to be used as a required task – the prompts in the LEGO activity, for example, promoted engagement with the resources. As a required task, a desire to continue with the build process may impel students to complete the SRL tasks.

It is important to note that I am measuring engagement in structured *play*; it is a measure of *voluntary engagement* – a measure of appeal. Averaging across all eight sessions and all three students, considering the context and the archetypal PRU student, the activities were generally cognitively, behaviourally, and emotionally engaging, with occasional signs of agentic engagement. I never had to divert attention to regulating student behaviour, and they were generally resistant to distraction. In summation, I found students to be sufficiently engaged with the activities; thus, if the activities are well-designed for the teaching and learning of metacognition, they may support PRU students in developing independency in learning, improving their academic outcomes, and facilitate their reintegration into mainstream settings.

Resources

I have created a booklet for construction-based play activities (see Appendix C); it provides an introduction to SRL, metacognition and play, the rationale behind the activities, guidance on making the resources, and descriptions of construction activities. The booklet is not prescriptive; in the spirit of a pragmatic approach to educational practice, it offers craft knowledge that can inform practice.

Changes to practice

I have found that the high-level of engagement with construction-based-play activities can provide a fruitful means to introduce essential knowledge and skills, especially to those students who are otherwise difficult to engage. With careful consideration of the design of activities and resources, fruitful and appealing play can be used to introduce knowledge and skills indispensable to teaching and learning, such as metacognition. As a practitioner, I have begun to consider ways of utilising construction-based play for a number of purposes aside from metacognition: for example, I am in the process of designing such activities for introducing the nature of science and scientific inquiry.

Reflective evaluation on the process

A significant challenge that I encountered was in my role as practitioner. Due to a lack of construction-based-play research in primary PRUs, I had to translate metacognitive indicators for my context, and this translation had to be undertaken in the course of conducting the activities. The analysis of the activities, and therefore judgements regarding the viability of the activities were based on the first conduct of the activities. Whilst analysing video and audio data, and constructing indicators through both deductive and inductive coding, I found that I was learning how to develop my role as practitioner conducting these activities: there were missed indicators and overlooked opportunities, underdeveloped exchanges and unattended

artefacts. The case study provided an opportunity to reflect on my own practice: my own role in the activities, and insight into how to better conduct that role.

Next steps

I intend to continue to develop the metacognition activities. I stated previously that the metacognition resources may be revised into a 'required task', and I maintain that this is a modification worth pursuing. However, it is worth noting that moving from play towards instruction removes responsibility from the learner, and thus *may* inhibit students' opportunities for self-regulation (Bonawitz et al., 2011; Robson, 2016; Whitebread, 2010); the correlation between greater saliency of metacognitive processes and degree of freedom in the marble run is suggestive of this. Thus, a balance between play and instruction is necessary. It would be better to seamlessly incorporate metacognition resources as part of the activity – my original intention – so as to improve engagement with these crucial elements, and this will require a consideration of ways to modify the activities to achieve this aim.

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