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Thinking Moves: Science

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Thinking Moves: Science

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Editors: Professor Geraldene Codina, Dr Adam Brett, Dr Stephanie King (University of Derby)

This [Action Research](#) case study was completed as part of the Department for Education (DfE, UK) nasen Universal SEND programme.

Abstract

Context: In a special secondary school setting, research was conducted to explore the integration of eight Thinking Moves in science lessons. This initiative aimed to enhance students' comprehension of scientific processes, specifically focusing on skills such as sequencing and vocabulary development, including the recognition of synonyms.

Aims: The primary objective of the research was to determine the impact of Thinking Moves on students' understanding of science. By facilitating a deeper exploration of scientific vocabulary and processes, the research aimed to enhance inclusive educational practices for students with special educational needs and disabilities (SEND).

Methods: The research was structured around two action research cycles. During each cycle, planning and implementation phases were undertaken, allowing the research question to evolve based on findings from preceding steps. Ethical considerations were paramount, with consent obtained from all participants to ensure the data could be published anonymously.

Findings: The introduction of Thinking Moves positively affected students' understanding of sequencing and science concepts. Participants demonstrated an improved ability to engage with scientific vocabulary, indicating that the strategy effectively supported their learning processes. The iterative nature of the research allowed for ongoing reflection and adjustment, contributing to a deeper understanding of the methods employed.

Implications: The study illustrates the potential benefits of structured frameworks like Thinking Moves in fostering inclusivity within science education for students with SEND. Other educators may take from this research the value of intentional vocabulary exploration and sequencing in lesson design, as well as the importance of iterative research practices in refining teaching strategies to meet diverse student needs. The ethical considerations highlighted within the research may also serve as a model for future studies involving vulnerable populations, ensuring respect for participant confidentiality and consent.

Keywords

Inclusion, special educational needs and disabilities; Thinking Moves; expressive language; metacognition; science education

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Action Research for Inclusion and Special Educational Needs and Disability (ISEND)

The introduction of eight Thinking Moves in Science lessons developed the young people’s understanding of science processes such as sequencing (order); this occurred by providing an opportunity to explore the meaning of words (including the noticing of synonyms): Special, Secondary School

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BACKGROUND INFORMATION

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|-----------------------------------|--|
| Type of setting | Barbara Priestman Academy is a Secondary Special provision in Sunderland, which in the North-East of England. Thinking Frames are well embedded throughout the school to facilitate a common framework, building confidence and independence. We have recently introduced Thinking Moves to further develop our common language for learning. |
| Age range of pupils | Key Stage 3 and 4 (age 11-19) |
| Roles of the Research Team | Ian Burke Role: Science Lead |

ACTION RESEARCH CYCLES

[Appendix 1](#) illustrates the Action Research Cycles

Ethical consent has been sought to publish this data anonymously.

SUMMARY

| | |
|--------------------------|---|
| Research focus | Metacognition, Thinking Moves, vocabulary, Science, special educational needs and disabilities (SEND). |
| Research question | How does the use of Thinking Moves impact on young people’s expressive language when planning/reporting a practical science activity? |

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| <p>Overview/Key information</p> | <p>Our setting has already embedded a Philosophy for Children (P4C) approach, as an addition to this, we wanted to add Thinking Moves¹ as a whole school approach. Thinking Moves is designed to provide a vocabulary (with actions) for thinking; it is described as a tool for thinking more purposely and decisively. In this research project, the focus is on using Thinking Moves in Science lessons. Throughout this case study, the Thinking Moves vocabulary is written in red text.</p> <ul style="list-style-type: none"> - For this research project, we introduced eight out of the twenty-six Thinking Moves to 17 young people working at Entry level with predicted achievement at level 1, 2 or 3 (age range 15-16). - The focus of the research moved from a focus on independence to a focus on expressive language. - It was found that as young people developed familiarity with Thinking Moves, they began to use a wider range of vocabulary to express the Thinking Moves A-Z words². - The development of a shared Digital Thinking Moves Journal became a valuable resource when explaining Thinking Moves to young people. - It was found that once young people were confident with a Thinking Move, they would begin to reduce the amount of language required to explain it, having assimilated the meaning of the Thinking Move into their lexicon. - When the Thinking Moves language was explored and understood by the young people, it facilitated a securer understanding of scientific skills; for example, the Thinking Move order became synonymous in science with sequencing, and enabled the young people to work using a sequencing frame. This meant that less time was spent on explaining what was needed, and more time was available for learning new ideas. - It was found that Thinking Moves have a hierarchy of use, with some being adopted much more quickly than others. |
| <p>Evidence-informed theory</p> | <p>The introduction of eight Thinking Moves in Science lessons developed the young people’s understanding of science processes such as sequencing (order); this occurred by providing an opportunity to explore the meaning of words (including the noticing of synonyms).</p> <p>The benefit of embedding Thinking Moves is that the moves can be explored in other curriculum areas (i.e. what does order mean in P4C?); thus, the young people’s understanding of language deepens and becomes more nuanced.</p> |

¹ Dialogue Works. (2025). *Thinking Moves*. <https://dialogueworks.co.uk/thinking-moves/>

² Thinking Moves (n.d.). *Thinking Moves A-Z: Metacognition Made Simple*. <https://www.thinking-moves.com/>

RESEARCH TIMELINE

| Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|--|-------|-----|--|------|-----|--|-----|-----|-----|
| Action Research Cycle 1 Step 1: Establish the research focus | Action Research Cycle 1 Step 2: Study Steps 3-5: Plan 1 | | | Step 6: Do 1 Steps 7-8: Review 1 Action Research Cycle 2 Step 9: Study 2 Steps 10-12: Plan 2 Step 13: Do 2 Step 14-15: Review 2 | | | Share and disseminate the research (anonymised) with other interested parties. | | | |

ACTION RESEARCH CYCLE 1

RESEARCH FOCUS: Step 1

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| Initial research interest aim/question (Step 1) | How does the use of Thinking Moves impact student independence in practical tasks? |
|--|--|

KEY LITERATURE SHAPING THE RESEARCH (STUDY 1): Step 2

| | |
|-----------------------------|---|
| Reference | Sherrington, T. (2019). <i>Rosenshine's principles in action</i> . John Catt Educational, Ltd. |
| Key point(s) of note | Applying key principles in our classrooms consistently can support students' learning and understanding and their ability to apply their knowledge to enable them to become more independent learners and thinkers. |

| | |
|-----------------------------|---|
| Reference | Mercer, N. (2019). <i>Language and the Joint Creation of Knowledge</i> . Abingdon: Routledge. |
| Key point(s) of note | Children's language competences and reasoning abilities develop through their interactions with others. Levels of confidence and skill in using spoken language can affect young people's life chances. |

| | |
|-----------------------------|---|
| Reference | Bloom, B., (Ed.). (1956). <i>Taxonomy of Educational Objectives: The Classification of Educational Goals</i> . Longman. |
| Key point(s) of note | "Some teachers believe their students should 'really understand,' others desire their students to internalize knowledge, still others want their students to grasp the core or essence or comprehend. Do they all mean the same thing?" |

PLAN 1: Step 3

As part of the process of planning Action Research Cycle 1 and having completed the 'study' phase, the research question can evolve and become further refined.

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| Revised research question | How does the use of Thinking Moves impact on young people's independence in practical science tasks? |
|----------------------------------|--|

PLAN 1 and DO 1: Steps 4 and 6

Methods of data collection

- Observation of existing work that predates the introduction of Thinking Moves.
- Levels of Student Independence Survey.
- Observation and evaluation of Thinking Moves lessons.
- 'Thinking Moves word bank' - this is a digital record of the language used by the young people when describing what each Thinking Move means to them.

Description of research sample, timing and location

Key focus group of 17 young people in Year 11 (aged 15-16) who were working at Entry level with predicted achievement at level 1, 2 or 3.

Practical tasks which used Thinking Frames were initially examined in folders which predated the introduction of Thinking Moves.

Three lessons per week were then evaluated over a period of three weeks, giving an overview of how Thinking Moves was used.

PLAN 2: Step 5

Ethical consent was sought from each participant to publish this data anonymously.

REVIEW 1: Step 7-8

Data Analysis: process

Having conducted the initial survey of existing work, a 'level of independence' was assigned to each young person. This was a simple 'marks out of ten' rating, with ten being a young person who worked entirely independently once a task was assigned and one being a young person who required full support at each stage.

This highly subjective number was then adjusted using observations from current lessons, which had already begun using Thinking Moves.

Standardisation of these values was achieved using a single researcher who made all judgements. Due to the small sample size, this was considered effective, as all evidence at this scale should be considered anecdotal. It was felt that this was the best way of generating a baseline or control, comparing and contrasting the same group of young people before and after the introduction of Thinking Moves (it was unethical to have a current control group who were not using a proven metacognitive technique, impact is being researched, not whether it works). The findings from this process were used to amend the research question and inform research cycle 2.

Summary of Findings

Research Question

At this point it became clear that the initial question had evolved considerably as the expressive language/technical vocabulary aspect of the project was becoming more of a focus, the question was restated as:

How does the use of Thinking Moves impact on young people's expressive language when planning/reporting a practical science activity?

Thinking Moves vocabulary is written in red below

- A young person's ability to express an idea and/or explain a process was a better metric for understanding the 'impact of Thinking Moves' than attempting to gauge students' independence, and gave a much more measurable set of data.
- As pupils became more familiar with Thinking Moves, they came up with new ways of using and explaining them.
- Novel, imaginative and creative language used to explain a move by one young person would often lead to someone else saying, "Oh, I get it now".
- Once a young person has the "oh, I get it" moment, they can begin to use the [Thinking Moves A-Z key words](#)³.
- Interpretation of Thinking Moves varies with context, it was interesting to note that moves such as **formulate** and **zoom** had concrete meanings when introduced as Thinking Moves and it was often quite challenging for young people to apply them in other ways; for example, from a science curriculum perspective, **formulate** is 'making a potion' and **zoom** is 'making something bigger with a microscope'.

Analysis and next steps leading into Action Research Cycle 2

It quickly became clear that the method of recording Thinking Moves use was having a direct influence on results. The digital journal was a document which was kept on the big screen in class. This was used to emphasise Thinking Moves as they were used, and, as we discussed the activity, new vocabulary was added throughout each session.

Young people very quickly began to refer to this journal as a learning resource/word bank and would challenge themselves to find new ways of expressing an idea and matching it to a move. At this point, the research question was revised; we were no longer looking at how Thinking Moves impacted practical independence, we were now looking at how expressive language was influenced when planning investigations and explaining results. This has an obvious impact on independence, but was not restricted to the purely practical aspects of sessions.

Next Step(s): Action Research Cycle 2

Research Cycle 2 focused on the expressive language being used by young people within science lessons. The digital journal was expanded into a PowerPoint-based interactive document (referred to below as the Digital Thinking Moves Journal), which was designed to be used as a learning resource as well as a digital journal of findings.

Each time a Thinking Move was used, the class would discuss what it meant, first as a general concept and then specifically in the context of this activity.

ACTION RESEARCH CYCLE 2

KEY LITERATURE SHAPING THE RESEARCH (STUDY 2): Step 9

| | |
|-----------------------------|---|
| Reference | Bigglestone, T., Buckley, J., & Sutcliffe, R. (2019). <i>Thinking Moves A-Z: Metacognition Made Simple</i> . One Slice Books. |
| Key point(s) of note | Teachers and students need a common vocabulary of thinking to use in inquiry and general learning. |

PLAN 2: Step 10

³ Thinking Moves A-Z. (n.d.). *Thinking Moves A-Z: Metacognition Made Simple*. <https://www.thinking-moves.com/>

Revised research question

How does the use of Thinking Moves impact young people’s expressive language when planning/reporting a practical science activity?

PLAN 2 and DO 2: Steps 11 and 13

Methods of data collection

- Lesson observation and evaluation (recorded in a research journal).
- Digital Thinking Moves Journal.

Description of research sample, timing and location

- Participants (sample): Year 11 focus group of 17 young people working at Entry level with predicted achievement at levels 1, 2 or 3.
- Science lessons were observed (particular focus on practical lessons), with the general use of Thinking Moves being noted in planning documents and when carrying out scientific investigations.
- A Digital Thinking Moves Journal was created, which enabled any new vocabulary or phrases to be recorded and shared with the group whenever a young person expressed an idea or explained a Thinking Move in a new way.
- Specific Thinking Moves were not decided upon prior to a lesson. It was decided that an organic approach was to be used. Relevant Thinking Moves were used as appropriate to the activity, each being added to the Digital Thinking Moves Journal as required, it was also noted which Thinking Moves young people favoured. As a result, during the time we have been focussing on this research we have not covered every Thinking Move, this provides a clear next step.

PLAN 2: Step 12

Ethical consent was sought from each participant to publish this data anonymously.

REVIEW 2: Steps 14-15

Data Analysis: process

Data gathered provided two key metrics:

1. **How often** an individual Thinking Move was used;
2. What **additional vocabulary** was used to describe the Thinking Moves or express ideas?

These two values were quite difficult to quantify in a comparable manner. It was thus decided that ‘use’ of a Thinking Move would be measured as:

- how many times was a Thinking Moved used when given ten opportunities?

Whereas use of ‘additional vocabulary’ was measured as:

- how many new keywords or phrases were used to describe each Thinking Move?

This provided two values that could be expressed as being ‘out of ten’. It’s important to note that these results are influenced by the small sample size and the interpretation of the researcher.

Summary of Findings

Action Research Cycle 2 Research Question

How does the use of Thinking Moves impact on young people’s expressive language when planning/reporting a practical science activity?

Summary of Key Findings

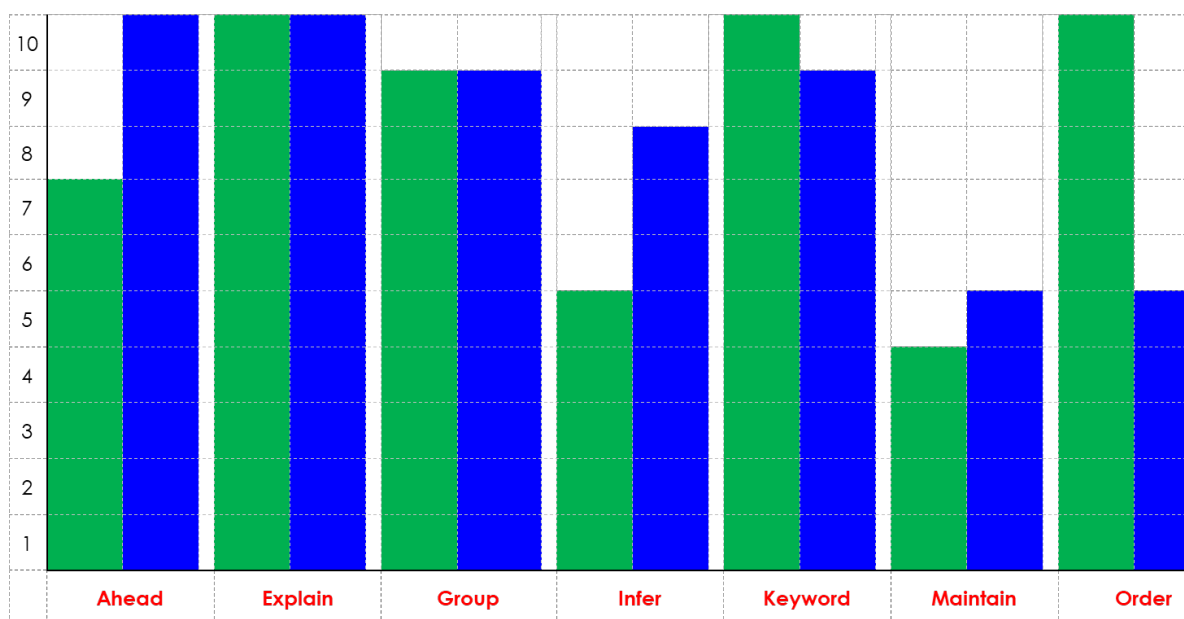
The eight Thinking Moves introduced to the group as part of this research were: **ahead**, **explain**, **group**, **infer**, **keyword**, **maintain**, **order**, and **weigh-up**.

- Newly introduced thinking moves provoked lots of discussion and new vocabulary. This started slowly, then accelerated with confidence and an element of competition.
- As familiarity with a Thinking Move grew, discussion and vocabulary development began to slow.
- Some moves were far more likely to be used independently at the beginning of the project. Most prominent were the Thinking Moves: **explain**, **keyword** and **order**.
- The range and variety of vocabulary used did not always correspond to the frequency of independent use. **Order** was a notable outlier with high use and low discussion/vocab.
- Once a young person has the “oh, I get it” moment, they can begin to use the [Thinking Moves A-Z key words](#)⁴ rather than lots of description and explanation.

The chart below compares the use of specific Thinking Moves to the amount of variation in vocabulary when describing them.

As an example, looking at the Thinking Move **Ahead**, the green bar shows that this move was used 7 times out of 10. The blue bar shows that the young people in the group developed 10 new ways of thinking or describing it.

Comparison between independent use of Thinking Moves and level of vocabulary



Key: **Independent use of thinking moves expressed as ‘times out of ten’**
Number of unique ways of expressing an idea/explaining a thinking move

Analysis and next steps leading to the research conclusion

The initial slow expansion of vocabulary was expected and reflected the young people building confidence with something new. Once a few suggestions were made by some of the more confident students, many others were able to engage, particularly when we emphasised that there were no wrong answers, we were just looking for the most interesting ones. This triggered competition to ‘get a new word on the screen’, which was an unanticipated but welcome result.

⁴ Thinking Moves A-Z. (n.d.). *Thinking Moves A-Z: Metacognition Made Simple*. <https://www.thinking-moves.com/>

This appears to be a result of the Digital Thinking Moves Journal boosting confidence and enabling young people to find similes, metaphors, and other alternate ways of expressing a thinking move.

CONCLUSION

Research aim/question

How does the use of Thinking Moves impact on young people's expressive language when planning/reporting a practical science activity?

Conclusion(s)

After the first stage of slow expansion followed by a rapid increase in vocabulary in related ideas, it was found that things slowed down, this corresponded to how often a young person would independently refer to or use a specific Thinking Move. This suggests that once the initial discussion and development of a move reaches a critical point, it becomes a core concept, the young people don't need to discuss it or have it explained, they can now simply use the word 'test' as it already carries all the vocabulary and understanding we have worked on. At this point, a Thinking Move is doing exactly what it is designed to do and provides a common language for learning. This works in conjunction with Thinking Frames, which give us a shared structure for laying out work and developing ideas. As an example, rather than explaining the process of planning an experiment in detail and guiding young people through each step, it is possible to simply say 'we need to order our steps'. The young people will then select a sequencing frame and simply get on with it. When we say order, everyone knows exactly what we mean; large amounts of repeated explanation are now unnecessary, meaning more time can be spent on new ideas and learning.

The word bank and vocabulary produced from this investigation would be expected to vary from group to group, topic to topic and between settings. Using the Digital Thinking Moves Journal, it would be possible for other settings to create their own differentiated, bespoke word banks. It would be exciting to compare these and potentially build a searchable reference with a wide range of 'ways you could explain this move'.

Within our setting, the Digital Thinking Moves Journal from this research project has already been used as a prompt when first introducing Thinking Moves to young people who are encountering them for the first time. This can then be added to, becoming a useful, interactive working display.

The implementation of Thinking Moves was facilitated by the cooperative nature of this research project (teachers and young people together). We developed our shared language for learning, then used the Thinking Moves to group language in specific parts of the Thinking Moves A-Z. This resulted in a much more personal and meaningful interaction than approaches such as flash cards with established definitions or pre-produced resources. Young people felt a sense of ownership of our new Digital Thinking Moves Journal and competed to add to it. This promoted engagement and was invaluable in developing the use of Thinking Moves within the group.

Conclusion

Uptake of Thinking Moves begins slowly, which is natural with anything new, as vocabulary and understanding increase, young people are more likely to select the Thinking Moves they have encountered and develop their deeper understanding of the vocabulary. Ultimately, the amount of new vocabulary and description begins to plateau; it was found that this indicated that a Thinking Move was now a concrete concept and could be used for planning, describing, and expressing ideas. Young people had a deeper understanding of what a particular Thinking Move could be used to express, and used it accordingly; it had become part of their expressive language toolbox.

Next Steps

Our initial project focused on eight of the twenty-six Thinking Moves due to time constraints. A clear next step would be to extend this to the full range of moves. The Digital Thinking Moves Journal is already in place and will be disseminated to colleagues across the school and ultimately across the Trust, as each school adopts Thinking Moves, this will increase our sample size and enable statistical analysis. Additionally, the Digital Thinking Moves Journal will become an adaptable resource when introducing Thinking Moves to both colleagues and young people.

Expanding the scope of this project to other subjects is vital, as we are already identifying Thinking Moves that are used in some contexts more than others. E.g. **formulate** is used quite readily in science but not in other subjects, the opposite is true of **maintain** and **yield**, which seem particularly useful for discussions in Philosophy for Children (P4C⁵).

⁵ Philosophy for Children, Colleges and Communities. 2025. *Welcome to P4C*. <https://p4c.com/>

Appendix 1 – Action Research Cycles

| | | | |
|--------------------------------|--|---|--|
| Action Research Cycle 1 | <u>Establish the research focus</u> | Step 1: Identify the ISEND area for development which requires research. | |
| | <u>Study 1</u> | Step 2: Review the research literature. | |
| | <u>Plan 1</u> | <u>First Plan</u> | Step 3: Start the process of refining the research. |
| | | Step 4: Decide what kind of direction you are going to take (direct or enquiry). | |
| | | Step 5: Consider research ethics (engage with the ethics checklist). | |
| | <u>Do 1</u> | Step 6: Implement the first plan (either direct action or enquiry as action). | |
| | <u>Review 1</u> | Step 7: Review and Reflect. | |
| | | Step 8: Analyse the meaning of the data gathered. | |
| Action Research Cycle 2 | <u>Study 2</u> | Step 9: Review further literature if required. | |
| | <u>Plan 2</u> | <u>Second Plan</u> | |
| | | Step 10: Based on the 'reflect' phase, refine the research (this may involve revising or developing the research questions) and plan the next actions. | |
| | | Step 11: Decide what kind of action you are going to take (direct or enquiry). | |
| | Step 12: Seek any further ethical permissions if needed (engage with ethics checklist). | | |
| | <u>Do 2</u> | Step 13: Implement the second plan – (either direct action or enquiry as action). | |
| <u>Review 2</u> | Step 14: Review and reflect. | | |
| | Step 15: Analyse the meaning of the data gathered. | | |