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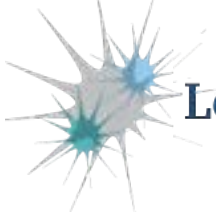

Learning Sciences Research Institute

Designing multimodal composition activities for integrated K-5 programming and storytelling

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Overview

Introduction	Research context
	Rationale of study
	Intervention design
Method	Design methodology
	Data analysis
Findings	Study 1
	Study 2
Discussion	Conclusions (and a caution!)
	Postscript

Research context

2008 — 2013 — 2015 — 2017

CSforALL

COMPUTING AT SCHOOL
EDUCATE · ENGAGE · ENCOURAGE
In collaboration with BCS, The Chartered Institute for IT


Department for Education

Computing programmes of study: key stages 1 and 2

National curriculum in England

Purpose of study

Aims

Attainment targets

(Department for Education, 2013)

(The Royal Society, 2017)

Rationale

"… computing education across the UK is ***patchy*** *and* ***fragile*** *…"*

(The Royal Society, 2017)

"…teachers have acted as gatekeepers to block a curriculum that they view as ***narrow, difficult*** *to teach and* ***in conflict with their beliefs and practices*** *as educational professionals."*

(Larke, 2019)

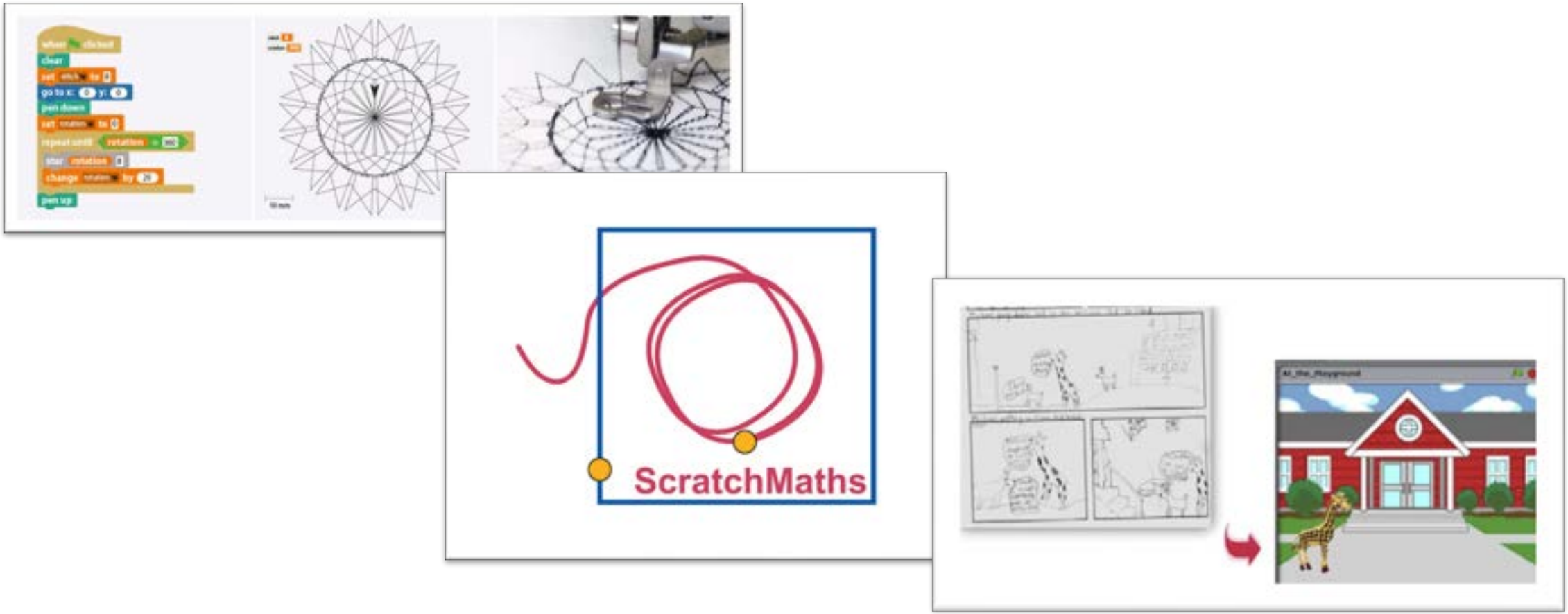
Rationale

"The core of computing is computer science… the principles of information and computation [**variables, loops, conditionals, parallelism, operators, and data handling**]… and put this knowledge to use through programming." (Department for Education, 2013)

Department for Education

"When will we use this in our lives?" (Tissenbaum et al., 2019)

Rationale



(Peppler, 2013; Benton et al., 2017; Burke and Kafai, 2010)

Integration of computing with literacy

- **Stimulate interest in computational activities** (Pinkard et. al, 2017)
- **Promote female participation** (Kelleher and Pausch, 2007)
- **Visual programming tools provide a visual narrative representation** (Robertson and Good, 2005)
- **Storytelling-based approaches are contested** (Adams and Webster, 2012)
- **“Literacy… benefited the least from learning to program”** (Scherer et al., 2018)

Multimodal composition (MMC)

Let's see what's behind that door," Harry called. The door creaked open. A deadly basilisk appeared.

"Expelliarmus!"

The Philosopher's Stone fell from its grip and into Harry's arms.

Multimodal composition

Definition

"A composition that employs a variety of modes, including sound, writing, image, and gesture/movement… [with] a communicative function"
(McGrail and Behizadeh, 2017)

Considerations

- The choice of representation
- The combination of representations
- The sequencing of representations
- 'Reader' effect (Bearne and Reedy, 2016)

Multimodal composition

Content and representation

Technical aspects for effect

Structure text

(Bearne and Reedy, 2016)

Methodology

Design-based research (DBR) (Cobb et al., 2003)

- Multiple cycles of iteration
- Investigating theory *in practice*
- Embedded in real-world settings

(Cobb et al., 2003)

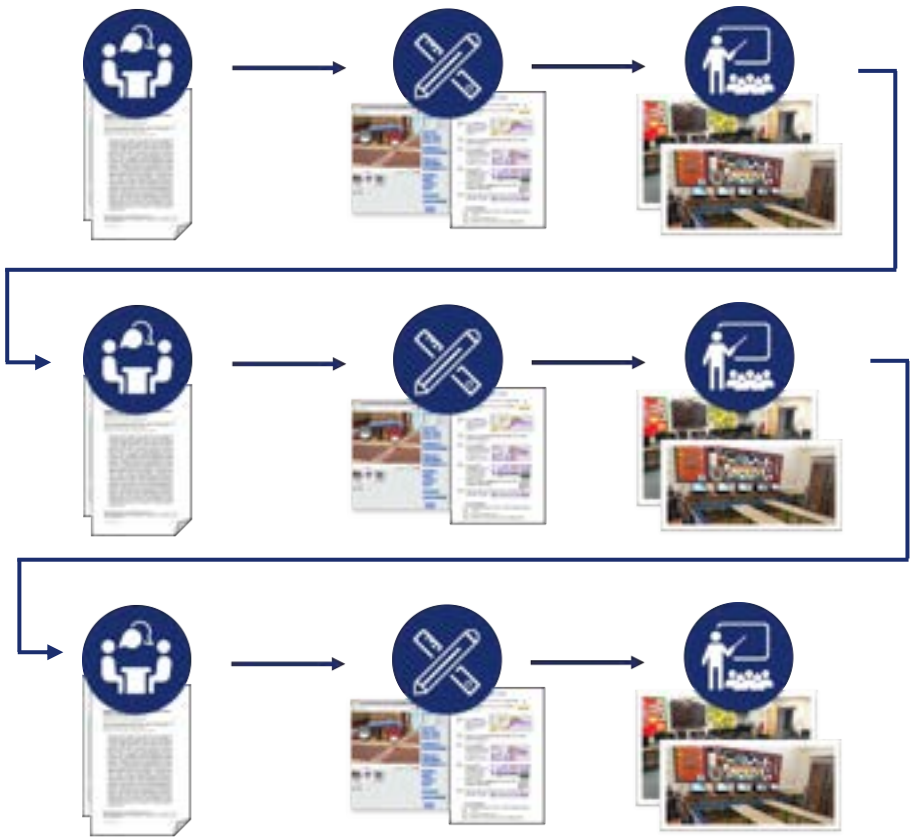
Methodology

Teacher interviews
+ CSED literature

Design principles +
Teaching materials
(curriculum unit: learning activities, lesson plans, scaffolding materials)

Facilitating classroom interventions +
evaluation of design

Research process



Pilot study: Piloting curriculum design

- Facilitating lessons
- Collecting process data
- Interviewing students and teachers

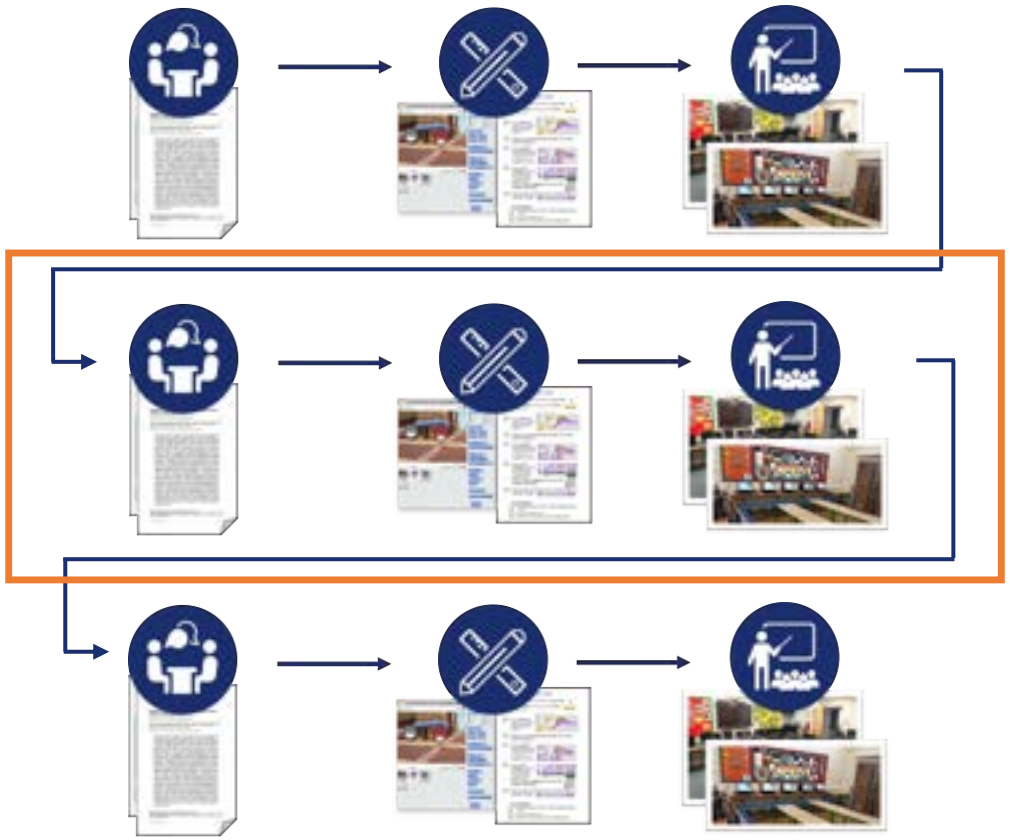
Study 1: Investigating the value of MMC

- Testing the curriculum design
- Trialing scaffolding materials
- Testing

Study 2: Adapting the curriculum for regular classroom instruction

- Curriculum co-design w/ teachers
- Classroom observations
- Developing teacher resources

Study 1



Research design — Study 1

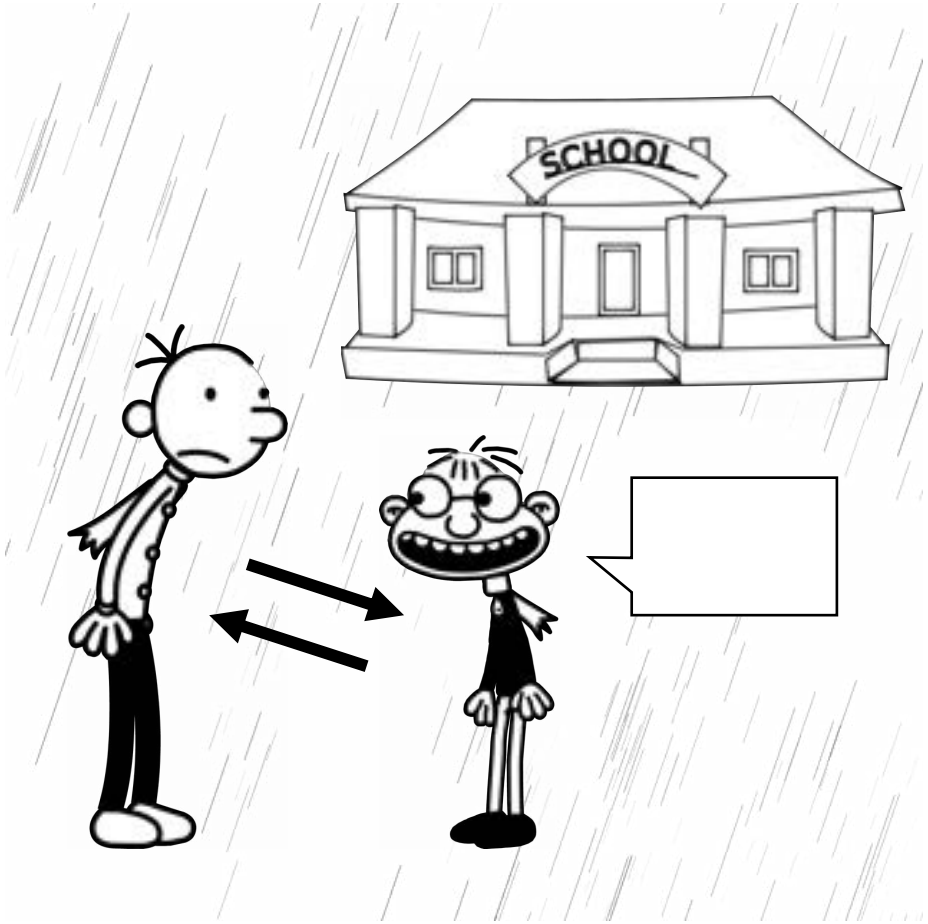
Aim	*How can multimodal composition activities be designed to support K-5 programming and storytelling practices?*
Location	Inner-city primary school, England
Participants	10 participants (9-11 y/o)
Intervention	6 weeks, 1hr weekly sessions (after school)
Data collected	Screen capture videos, audio transcripts, Observation notes, participants' projects

Intervention design

- Adapted one unit from the Creative Computing Curriculum (Creating Computing Lab)
- Characters -> conversations -> scenes

(Balch et al., 2014)

Intervention design



Intervention design

#	MMC activities	Storytelling	Programming
1	Decide on representation and content for specific purposes	Define narrative goal and decide on representations	Initialise sprites and write sequences
2	Structure texts	Maintain story cohesion through cohesive devices	Manage execution and coordination through event-based programming
3			
4	Use technical features for effect	Use technical features for specific effects (e.g. narrative tension, to engage the audience)	Use programming features to animate sprites and create motion
5			
6	Program an original multimodal story	Create a narrative text and employ multimodal features for effect	Use a variety of programming concepts and practices to create a multimodal story, using more sophisticated programming features for narrative effect

(Bearne and Reedy, 2016; Balch et al., 2014)

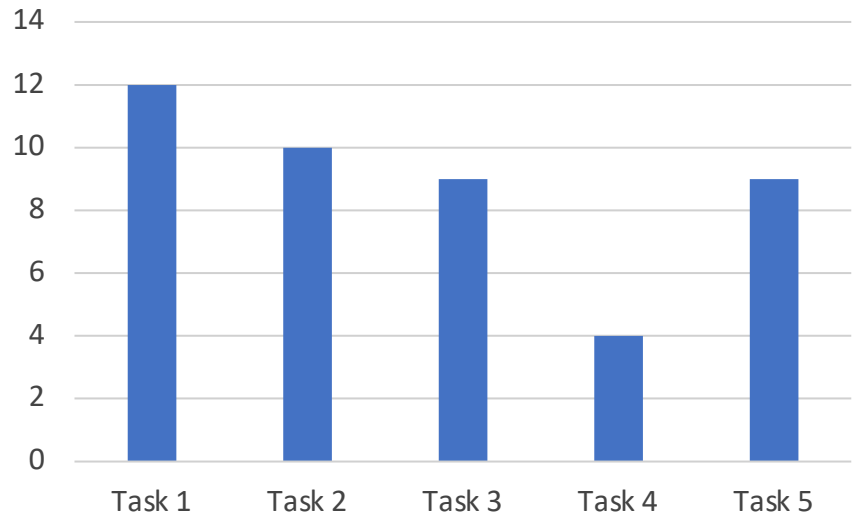
Intervention analysis

- Challenge of simultaneously assessing student work as **programming** and **storytelling**
- Inspired by work in the learning sciences (esp. mathematics education) in hypothetical learning trajectories (Simon, 1995) and conjecture mapping (Sandoval, 2004)
- Adapted task-oriented analysis… or **analyses** (Dierdorp et al, 2011)

Intervention analysis

Activity A: Creating an introduction to a story

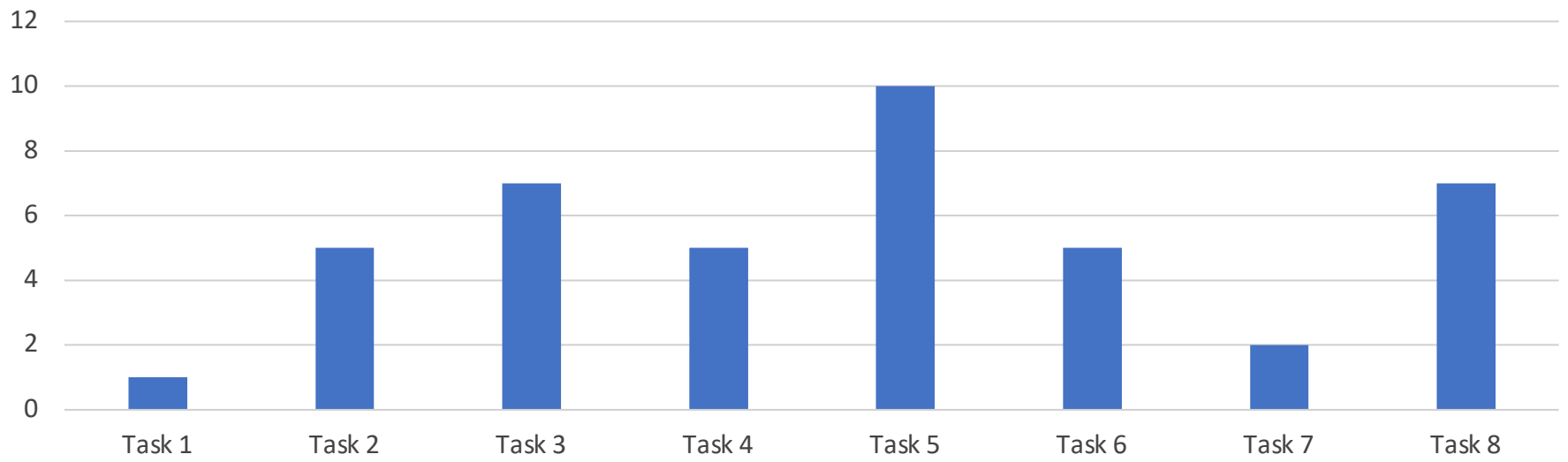
#	Task	Result
1	Introduction characters (appearance)	12/12
2	Provide character details (behaviours, background information)	10/12
3	Establish setting	9/12
4	Illustrate narrative events using dialogue	4/12
5	Illustrate narrative events using exposition (e.g. a narrator)	9/12



(Adapted from Dierdorp et al., 2011)

Intervention analysis

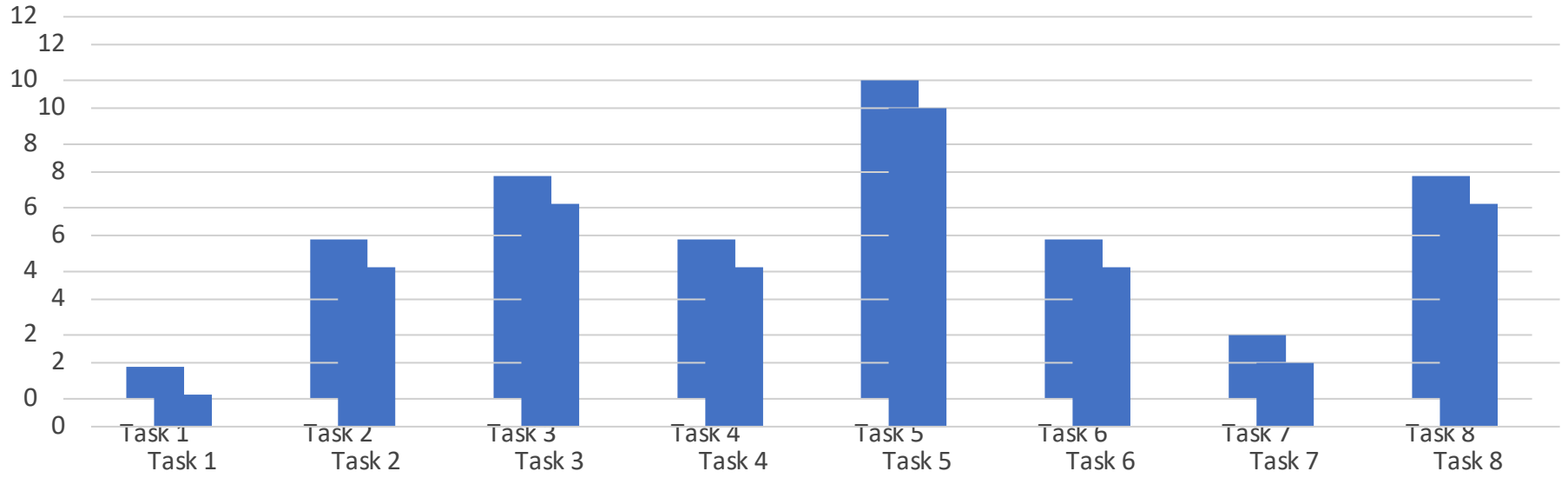
Activity A	1	2	3	4	5	6	7	8
Result	1/12	5/12	7/12	5/12	10/12	5/12	2/12	7/12



(Adapted from Dierdorp et al., 2011)

Intervention analysis

Activity A	1	2	3	4	5	6	7	8
Storytelling	1/12	5/12	7/12	5/12	10/12	5/12	2/12	7/12
Programming	2/12	5/12	5/12	3/12	11/12	5/12	3/12	8/12



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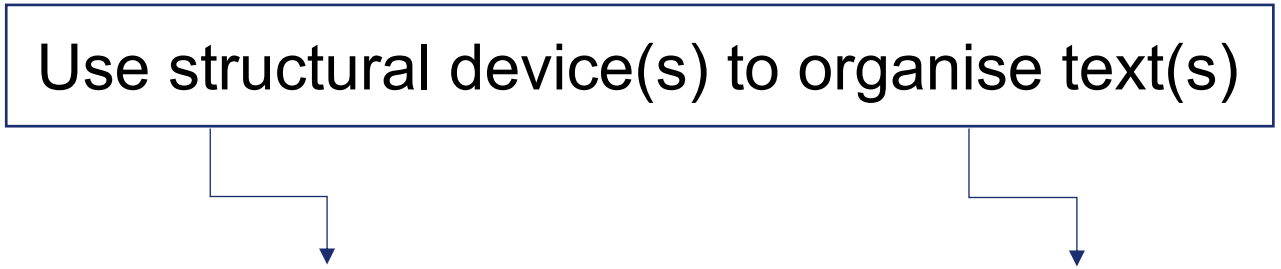
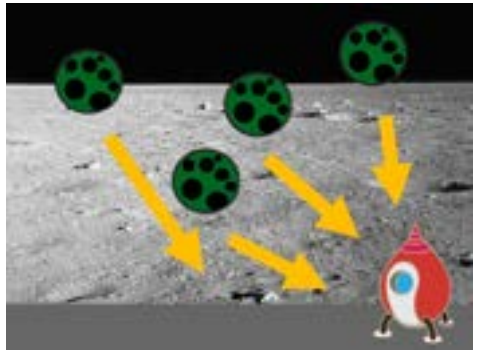
Intervention analysis



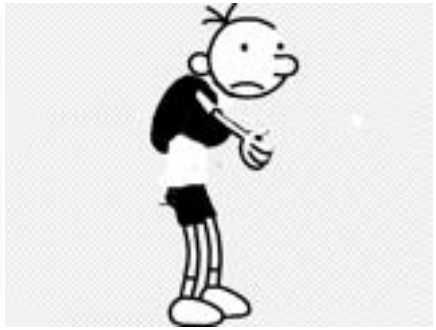
Storytelling	Programming
Sequence story events for cohesion	Use *wait* block(s) to sequence narrative correctly
Organise longer compositions using structural devices	Use *broadcast message(s)* to coordinate multiple processes
	Use initialising block(s) (e.g. *when* blocks)

Student projects

- Rich examples of student-led projects
- Use of popular books (Harry Potter, Diary of A Wimpy Kid) and media (Minecraft, Battle Royale)



MMC as *storytelling*

- Multiple representations used for specific purpose (10/10)
- Structure texts with event-based blocks (10/10)
- Use of motion/animation (7/10)
- Reflect on MM choices (9/10)

MMC as *programming*

- Reset objects for multiple program execution (9/10)
- Event-based programming features (10/10)
- Loop functions (6/10) to simulate motion and animate characters

Task-oriented analysis

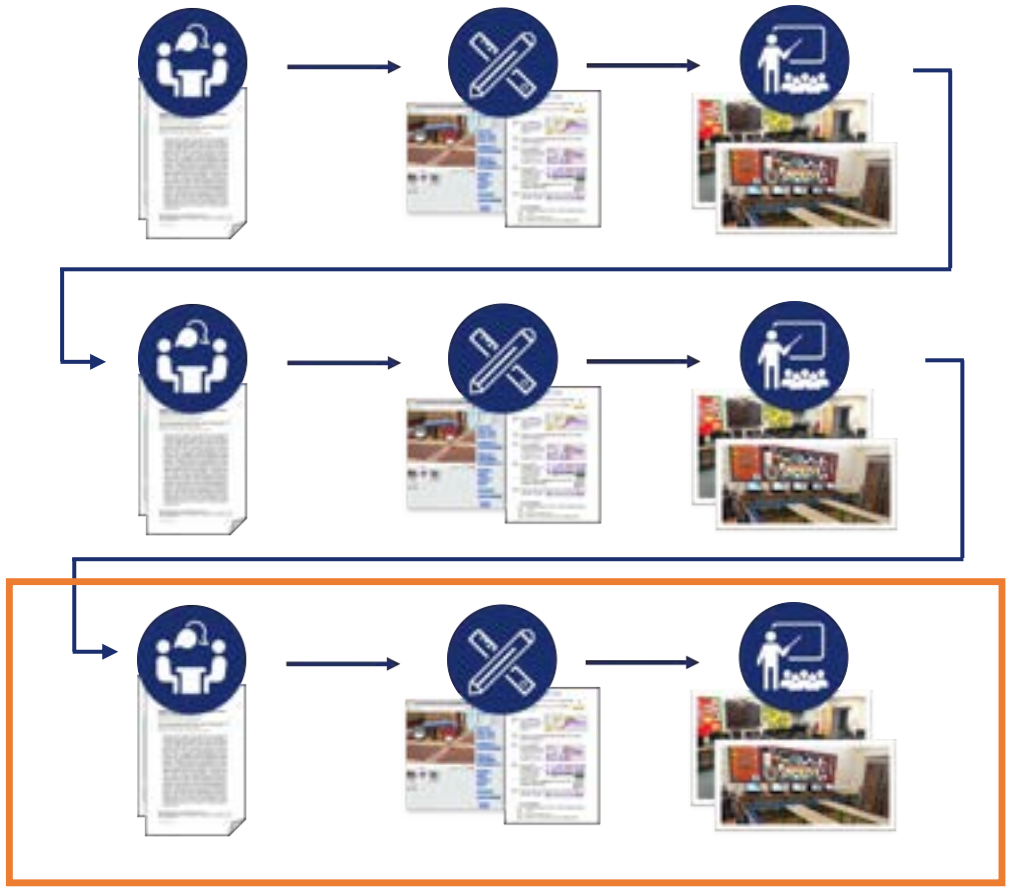
MMC subtasks	Conjecture (storytelling)	#	Conjecture (programming)	#
Decide on representation and content for specific purpose and audience	Define narrative goal	10	Define program goal	10
	Select appropriate representations to express story elements (e.g. images or words for characters or dialogue)	10	Employ one or more backdrops/sprites	10
	Adapt content to suit personal intentions or narrative goal	9	Execute two independent sprites concurrently	10
	Use multimodal features to engage and hold a 'reader's' attention	9	Manipulate elements to personalise characters/objects/setting	9
Structure texts	Integrate and balance representational resources for narrative purposes	10	Use an initialising block (e.g. green flag)	10
	Vary background detail to create changes in setting	10	Define initial sprite state using show/hide block(s)	10
	Use structural devices to ensure cohesion (e.g. when blocks)	9	Use event-based block(s) to manage program execution	10
	Use structural devices to organise longer compositions (e.g. broadcast messages)	5	Use broadcast scripts to coordinate multiple processes	5
Use technical features for effect	Illustrate action/movement using multimodal features	10	Use motion-based blocks (e.g. glide) to simulate movement	10
	Use layout and sprite organisation for narrative effect	10	Use switch costume/backdrop block(s)	10
	Use technical features to enhance meaning	8	Employ loops to animate sprites	6
Reflect	Check narrative cohesion	8	Ensure program output is consistent	10
	With support, redesigns text for clarity or cohesion	10	Debugs program errors	9

Design modifications

- ❑ Embed meaningful examples in activities → ❑ Provide additional examples of loop applications
- ❑ Additional instructional supports →
  - ✓ Explicit instruction on storytelling
  - ✓ Explicit instruction on broadcast messaging

(Whyte et al., 2020)

Study 2



Research design — Study 2

Aim	*How can multimodal composition activities designed to support K-5 programming and storytelling be adapted to support regular classroom instruction?*
Location	Inner-city primary school, England
Participants	28 student participants (9-10 y/o), 1 teacher (coordinator)
Intervention	2 weeks, 1hr daily sessions (during schooltime)
Data collected	Audio transcripts, observation notes, participants' projects, **interview data**

Findings — interviews

Areas of focus	**Responses**
Participant experience (students and teacher)	***"I enjoyed thinking of… things that have affected my practice"***
Perceived enhancing or inhibiting factors or strategies	***"Time is critical […] otherwise it won't be usable."***
Intervention adaptation and future use	***"[I wanted] the lessons [separated] so that I teach one computer lesson and then a literacy lesson […] "***

(Tracy, 2012)

Findings — interviews

Teacher and student experiences

- Students appreciated a longer multi-session project
- Classroom teacher satisfied with the project work completed/skills practices (***review of task-oriented analyses)***
- Teacher required resources and planning to be made available and explicit (***“I needed you to turn up [with] all the resources and planning […] and I'll be able to just deliver it”***)

Findings — interviews

Perceived enhancing or inhibiting factors

- Confidence in teaching programming was a factor (***"I don't see myself as a coder"***)
- Challenge of differentiation in computing (***"[It's hard] differentiating for how much access they've had"***)
- School expectations and high standards meant that the lesson was perceived as being Literacy-lite (***"Would they see this as a "wasted" literacy lesson?"***)

Findings — interviews

Intervention adaptation and future use

- Challenge working with MMC texts — needed additional teacher guidance on modelling texts
- Intended to separate computing and literacy activities in future lessons
- Proposed making open-ended projects more prescriptive to limit time spent troubleshooting student projects/concerned over ability to do so

Conclusion

- MMC provided multiple opportunities for learners to mutually pursue storytelling and programming goals
- Curriculum unit proved feasible and adaptable for teachers to integrate into classroom practice
- ⚠ Cross-curricular integration projects require that the affordances/trade-offs of bringing together different content areas are carefully considered

Postscript

- ***NEW*** animated text features in Scratch Labs (here)

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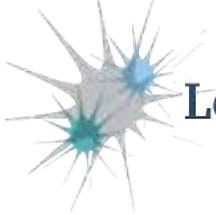

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