Delving Deeply Into Interviews With Timeline Tools

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Semi-structured interviews are used to gain insights into participants' lived experiences and perspectives on issues, but they are open to subjectivity. To address this issue our study explored the combination of timeline graphic elicitation tools with semi-structured interviews as an approach to gain insights into teachers' experiences of mathematics teaching and professional learning. A qualitative study was conducted with ten participants from two schools who took part in professional learning activities for mathematics teaching. Findings indicated that combining these instruments can support researchers in gathering deeper insights into teachers' lived experiences.

Oral histories are personal memories and commentaries that hold historical significance and are commonly used for research. These memories offer insights from individuals deeply involved in the research subject matter (Galletta, 2013). Capturing participants' oral histories via semi-structured interviews offers valuable insights into lived experiences. Through a balance of flexible, open-ended questions and well-prepared structured interview questions, researchers can delve deeply into participants' histories (Kervin et al., 2016). Semi-structured interviews are a versatile method that allows researchers to explore lived experiences and investigate questions arising from existing theories (Galletta, 2013).

While semi-structured interviews are widely used in research, it can be argued that they have limitations. Charmaz (2014) pointed out a "common criticism of interviews is that they are tainted by the participants' subjectivity" (p. 80). Kervin et al. (2016) concur that participants' reflections during interviews may be influenced by limited, biased, or inaccurate recollections, as well as varying degrees of articulation. To ensure participants feel safe and comfortable, physically, mentally, and socially, it is critical to enhance our understanding of how "tools" might support emotions and reflections during interview design.

Incorporating graphic elicitation tools into the design of semi-structured interviews may assist mathematics education researchers in overcoming these limitations. Such tools are commonly used in the arts, psychology, and social sciences (Bravington & King, 2019), but are only emerging in mathematics education research. Lewis (2013) described them as a novel method of reflection while Galetta (2013) claimed they could help to elicit a narrative and shed light on participants' experiences. Providing tools to support mathematics teachers' reflections may deepen interview narratives and provide insight into significant events.

As part of the first author's PhD studies, a combination of timeline graphic elicitation tools and semi-structured interviews were used to collect data. This paper presents reflections on combining these instruments and methods to gain insights into teachers' experiences of mathematics teaching and professional learning (PL). The specific research question is:

- How might the combination of timeline graphic elicitation tools and semi-structured interviews support researchers to gain insights into teachers' experiences of mathematics teaching and professional learning?

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Graphic Elicitation Tools

This section presents the literature review with a focus on graphic elicitation and the use of timeline tools in mathematics education research.

Graphic elicitations are drawings or diagrams that may be produced by the researcher or participant as a contemporary addition to a conventional interview (Bagnoli, 2009; Crilly, 2006). Self-portraits, chain, hub and spoke, and network diagrams, photographs, timelines, and continuums are common variations (Bagnoli, 2009; Bravington, & King, 2019). From a researcher's perspective, combining graphic elicitation tools with a semi-structured interview "allows one to see things from different perspectives and to look at data in creative ways" (Bagnoli, 2009, p. 567) while gathering "rich and nuanced data" (Crilly, 2006, p. 342). From a participants' perspective, graphic elicitation tools may help participants to reflect on their experiences when conveying them to the researcher. For example, diagrams are effective tools to express one's thoughts and to communicate those thoughts to others (Crilly, 2006). In addition, graphic elicitation tools may provide a basis to elicit a deeper level of communication and reflection and encourage thinking in non-standard ways that may be difficult to obtain by other means (Bagnoli, 2009; Crilly, 2006). For example, Bagnoli (2009) described the use of self-portraits as a useful tool to *break the ice* in an interview while participants simultaneously expressed their identities through drawings.

Graphic elicitation tools have become increasingly popular among researchers (Bravington & King, 2019). Recently graphic elicitation tools in the form of timeline tools have been used to aid qualitative mathematics research. Timeline tools may be used to "collect the most important turning points and biographical events" (Bagnoli, 2009, p. 561) as seen from participants' perspectives. Lewis (2013) used a timeline tool to capture high school students' reflections of mathematics, whereas Bobis et al. (2021) used a similar timeline tool to explore teachers' development of mathematics identity. Combining a semi-structured interview with a timeline tool in this way yields insights into the impact of events that may not have been obvious to participants (Bobis et al., 2021). Furthermore, this combination of methods supports participants when explaining how and why experiences were considered impactful (Bobis et al., 2021.

As a "novel quantitative" method (Lewis, 2013, p. 76), the timeline tool allows teachers to reflect upon their perspectives and past experiences and consider what events were influential in developing their mathematics teaching practice. Corovic and Downton (2021) found the "inclusion of the timeline tool facilitated questioning to generate rich dialogue and valuable reflections" (p. 160). Semi-structured interviews allow for the conversation to be simultaneously flexible in design, moving within the flow of conversation, yet holding the ability to dig deeper into the research phenomena in a safe and trusting environment.

Method

To conduct the research, a qualitative method was used which involved combining a timeline graphic elicitation tool (see Figure 1) with semi-structured interviews.

Context and Participants

Ten participants were selected from two schools (based on specific characteristics required for the PhD study) using a purposive sampling method (Palinkas, 2015). Five teachers from each school agreed to participate in the study. They were all involved in a Foundation to Year 2 mathematics (students aged 5 to 8 years old) PL focused on teaching sequences of challenging tasks, facilitated by Emeritus Professor Peter Sullivan.

At School A (Melbourne Catholic school) teachers were selected by school leaders who perceived that the Year 1 team (n = 2) were resistant to changing their practice while the Year 2

team ($n = 3$) at the same school had embraced the PL practices. These five teachers had experienced the same PL, school context, and support, yet had different PL outcomes. While the PL method varied slightly for School B (Melbourne Government school) these teachers were teaching the same year levels as School A (Year 1 teachers $n = 2$, Year 2 teachers $n = 3$) and were also selected for the study.

Instruments

Two instruments were used in this study: a timeline graphic elicitation tool and an open-ended semi-structured interview. Both are explained next.

Semi-Structured Interview

An interview guide informed by Galletta's (2013) framework was developed. The guide had three parts. Part one was designed to discover participants' previous experience with mathematics education and to develop a positive and safe rapport between the interviewee and researcher. Part two focussed on open-ended questions to provide opportunities for teachers to provide commentary on their PL experiences. Part three was designed to provide time to clarify ideas and provide a final reflection. Questions throughout the guide aimed at gathering information relating to teachers' experiences including what the experiences were and their impact on teachers' practice.

Timeline Graphic Elicitation

Combining a timeline graphic elicitation tool with semi-structured interviews was inspired by the work of Bobis et al. (2021). After careful investigations and deliberation, revisions were made to the tool. These revisions were informed by Lewis' (2013) and Baglioni's (2009) versions and Murdoch and Wilson's (2004) student reflection timeline tool. Three sample tools were developed. After testing, discussing, and modifying, one tool was selected for the PhD study and used twice during each participant's interview, but with a different focus.

Data Collection and Analysis

For data collection, the first author conducted interviews with each participant using the timeline tool. School A's interviews were held online via Zoom due to COVID-19 in August 2021. School B's interviews were held in person in November 2023.

Prior to the interviews, participants completed the first timeline tool to elicit information about their previous experiences with mathematics education, starting from their preservice teacher education up until their recent participation in PL. Responses were brought to the interview by the teacher and used to help initiate discussions. Time was allocated during the interview (5 minutes approximately) to complete the second timeline tool. This tool focused on gathering information about teacher's experiences in recent mathematics PL. Each interview took approximately 45 minutes. Interviews were video recorded and then the audio was transcribed for data analysis. The completed timeline tools were also kept for analysis. The authors then watched the videos to record the frequency of teacher gestures, specifically pointing to the timeline tool. Data collected was used to respond to the research question.

An inductive thematic analysis was conducted using all forms of data collected: interview transcripts, non-verbal communication (pointing gestures), and timeline tools. Braun and Clarke's (2006) six-phase guide to performing thematic analysis was used. Following a phase of data familiarisation, initial codes were generated by the researchers. Codes were collected and sorted into potential themes such as: breaking the ice, alleviating anxiety, novel methods to collect nuanced data, capturing insights that were not immediately obvious, and insights into event influence. The themes were defined and named, and finally, extracts were selected to communicate the results. For this paper, we report on the use of instruments to gain insights into teachers' experiences of mathematics teaching and PL.

Results and Discussion

This section provides a brief overview of using the timeline tool and semi-structured interviews. Five themes will be discussed. Only one timeline tool example is included due to page limitations.

Breaking the Ice

Completing the timeline tool prior to the interview most likely helped participants prepare for the interview by reflecting on experiences that had influenced their mathematics teaching practice. This conclusion was confirmed because few prompts by the interviewer were required to instigate conversations. Teachers easily explained their recordings on each timeline tool, and they were able to take the lead in the conversation. This was evident as teachers pointed to and unpacked their responses. Table 1 shows the number of times each teacher participant pointed directly to their timeline tool.

Table 1

Frequency of Teacher Pointing to the Timeline Tool

Teacher	Timeline tool 1	Timeline tool 2
Andy	9	5
Nadia	17	9
Phoebe	2	3
Evelyn	2	2
Olivia	11	11
Ella	8	5
Ceilia	22	9
Celeste	25	6
Eliza	8	5
Natalie	8	12
Average	11.2	6.7

As shown in Table 1, teachers (pseudonyms used throughout) referred to, by pointing, the first timeline tool on average 11.2 times and the second timeline tool 6.7 times. Teachers were likely to point to the first tool more as there were more plot points drawn on them compared to the second tool. This is largely due to the first tool seeking reflections of teachers' career experiences, whereas the second tool was of a specific duration (two years for School A and one year for School B). For example, Ceilia (see Figure 1) drew seven plot points on her first timeline tool and three plot points on her second timeline tool. During the interview, participants frequently pointed to their recordings which helped them to 'open-up' and share reflections of their experiences. This suggests that the tool was effective in *breaking the ice* and encouraging conversations, as proposed by Bagnoli and King's (2009) notion that graphic elicitation can support interviews.

Alleviating Anxiety

Several teachers were noted to appear highly anxious at the commencement of the interview. This was evident in their body language, voice, and their expression of nerves. The combination of instruments appeared to help ease anxiety as the teachers drove the conversation and elaborated on various teaching events. Ceilia was an example of a teacher who arrived at her interview feeling very nervous. During the interview, the interviewer observed that Ceilia's voice was quavering; she laughed nervously and sat with her arms crossed l. However, as soon

as the interviewer asked Ceilia to explain her first timeline tool (see Figure 1), she began to relax.

Figure 1

Ceilia's Timeline and Written Reflection of Teaching Experience Over Time (First Timeline Tool)

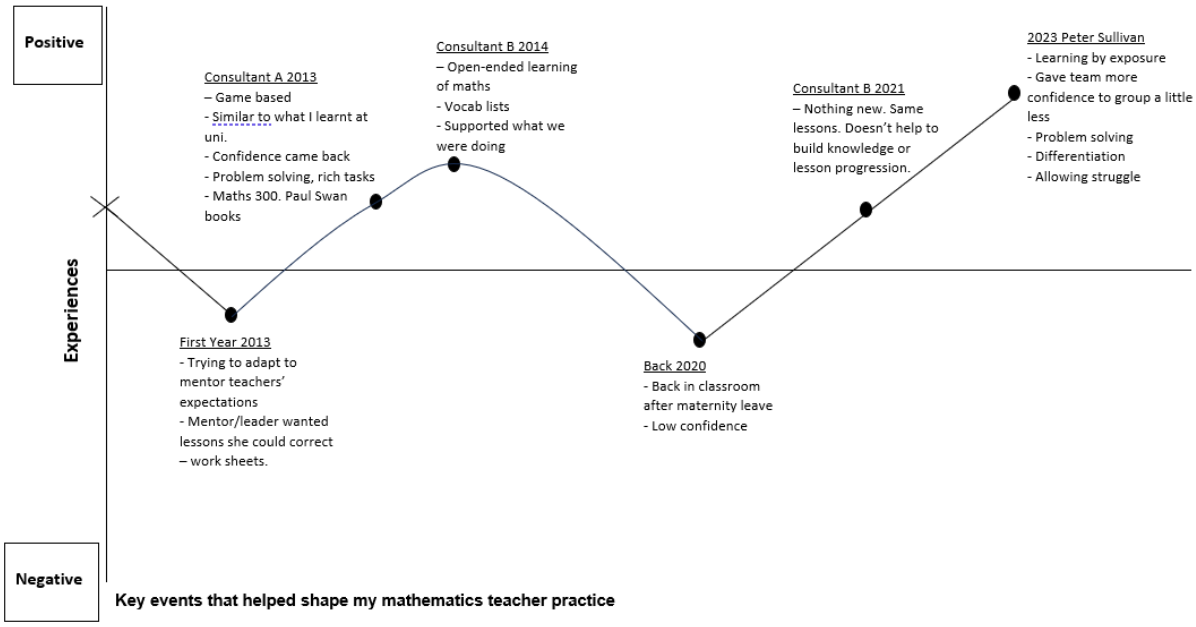

Figure 1 shows Ceilia's completed timeline tool of experiences that impacted her mathematics teaching practice. This response has captured background information related to the teaching experience of a particular teacher. It includes the duration of her teaching career, the schools she has worked at, the year levels she has taught, and any significant events that have influenced her mathematics teaching practice. While Ceilia was nervous to begin with, halfway through the first prompt she used her right hand to point to the timeline tool indicating the point she was referring to. Soon after she began to use her right hand to gesture. Ceilia began using two-handed gestures at 1.26 minutes into the interview. She spoke expressively while elaborating on her discussion points. The timeline tool provided an effective instrument for gathering Ceilia's historical data. Moreover, the instruments appeared to assist with alleviating anxiety by providing something for her to focus on stimulating the conversation.

Capturing Insights That Were Not Immediately Obvious

The combination of tools supported teacher reflections. This was evident as teachers were prepared to discuss experiences recorded on their timelines. In addition, most of the teachers added further reflections to their remembrances during the interview. At times the conversations deviated from a point on the timeline tool and revealed additional insights. Such was the case in Evelyn's interview. She alluded to her colleagues having an impact on her adoption of the PL practices. By probing into this additional information, the interviewer was able to capture further insights that weren't immediately obvious:

Interviewer: Then you've gone up again [pointing to planning on the timeline tool]. So, what have been some of the positives that have affected you?

Evelyn: So, I think that that planning, planning with someone. The observation was so helpful and the conversation we had afterwards. I know I got a lot out of it. That idea that it's not just scripted [the PL provided resource materials]. So, I think I was getting caught up with some of the other [team] talk which is 'oh no we have to go exactly by the book'

Interviewer: How was it helpful?

Evelyn: I think we've [team] kind of got to the point where we weren't reading the chapters [of the PL supplied resource book containing sequences of lessons], we were just looking at the activities. … I think

I lost a bit of track because the people around me had lost track. It was really good for me to be brought back into it and I think I just needed that refresher.

Interviewer: So, the team environment is having an impact on your participation in the learning and adoption, is that right?

Evelyn: I wish it was a bit more … I wish I could dive into it properly, but I can't [due to the teaching team environment]. So, it can be a bit demotivating.

This extract from Evelyn's interview highlights that while she began discussing an experience that had a positive impact on her, *planning*, she reflected on her needs as she spoke and revealed that her teaching team had a negative impact on her adoption of the PL practices. This had not been recorded on her timeline tool. Therefore, it was through a conversation about planning that she recognised that the team had had a significant impact on her. Due to the nature of a semi-structured interview, the interviewer was able to probe deeper into the experience to provide additional insights that were not immediately obvious to the participant. The combination of instruments supported reflection prior to, and deeper reflection during, the interview.

Rich Data

The combination of tools assisted in collecting rich data in a novel manner. Teachers' completed timeline tools provided an innovative way to collect historical data and the interview provided an opportunity to collect additional data of interest to the interviewer which had not yet been captured on the timeline tool. This was evident in Ella's interview:

Ella: In 2019 we did a walk-through where teachers had to do a maths lesson and parents and the principal watched.

Interviewer: What made this experience so impactful?

Ella: I think it was really hands on and we made it cross curricular. … We were doing maths, but it was linked to our [class] novel. The kids were really into it.

Interviewer: What grade were you teaching then?

Ella: Year 3

From this conversation with Ella, the data gathered included the following:

- Teaching background: In 2019 Ella was teaching Year 3;
- Significant events: A mathematics walk-through with parents and the principal;
- Impact of the event: It was hands-on, cross-curricula, and kids were into it;
- The degree of the impact: Very highly positively ranked on the timeline tool.

The extract illustrates how the timeline tool and interview supported data collection related to participant background information (teacher experiences) and insights into research phenomena (impact on teacher practice). This combined approach to data collection supported a rich understanding of the teacher's experiences.

Insights into Event Influence

Completed timeline tools provided an indication of the level of impact experiences had on teachers' practice. Conversations during interviews provided a greater depth of insight into the significance of these experiences. This was evident in Nadia's interview. Her timeline tool recordings indicated positive and negative experiences. She recorded the *new format* (pedagogical approach) as significantly low on the vertical axis and the *resource book* (support materials) as mildly low, indicating both were negative experiences for her. In contrast, Nadia recorded *colleagues* as mildly high on the positive side of her timeline tool, indicating a positive impact on her teaching practice. The extract below commences with Nadia explaining these first three points:

So, I've got the new format to maths lessons being quite raw and uncertain about where I was headed … and the introduction of the resource book.

> Looking at those chapters and really breaking it apart, definitely helped.
>
> Working with colleagues and I'd say, working with and progressively even better as the year developed last year. I know [Maths Leader] was a big help in that way for me 'cause I really loved her modelling.

This extract shows how the data gathered in the interview complements the timeline tool by providing additional insights into Nadia's experiences. The timeline tool indicated some level of impact, however, the interview conversation allowed for further insights into the significance of the event. Without the timeline tool, the level of impact would be difficult to ascertain, or further questions in the interview would be required.

Conclusion

This study intended to explore the combination of timeline graphic elicitation tools with semi-structured interviews as a qualitative methodological research approach to gain insights into teachers' lived experiences. The findings demonstrated the effectiveness of this approach in facilitating conversations, alleviating perceived interviewee anxiety, and deepening reflections. The timeline tools emerged as valuable aids in prompting discussions about participants' teaching backgrounds and experiences with professional learning. Notably, participants frequently referenced the recordings they had made on their completed tools, underscoring their utility in shaping, and stimulating conversations.

This research contributes to the evolving landscape of qualitative research methodologies in mathematics education by building on Lewis's (2013) use of timeline tools as a novel method of reflection. Our findings suggest that in addition to supporting participants' reflections, the combined method may assist in fostering in-depth exploration of their experiences. As educational research increasingly recognises the importance of participants' perspectives, this study offers a valuable method for researchers seeking to employ innovative instruments that engage and empower participants. As Bobis et al. (2021) noted, the combination of timeline tools "encourages participants to provide rich descriptions of past experiences" (p. 137).

We acknowledge that a limitation of this study was focussing on one methodological approach, which may overlook potential insights gained from comparing or broadening approaches. However, the combined use of timeline graphic elicitation and semi-structured interviews emerge as an avenue for future investigations, offering researchers an innovative tool to capture nuanced data and deep insights into teachers' lived experiences of teaching, and professional learning in mathematics. Future studies that compared interview data captured with and without the timeline tool, and the use of other graphic elicitation tools would be of benefit.

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References

Bagnoli, A. (2009). Beyond the standard interview: the use of graphic elicitation and arts-based methods. *Qualitative Research, 9*(5), 547–570. http://doi.org/10.1177/1468794109343625

Bobis, J., Nguyen, J., & McMaster, H. (2021). Exploring the 'high' and 'low' points in primary preservice teachers' mathematics identity. In Y. H. Leong, B. Kaur, B. H. Choy, J. B. W. Yeo & S. L. Chin (Eds.), *Excellent in mathematics education: Foundations & pathways*. *Proceedings of the 43rd annual conference of the Mathematics Education Research Group of Australasia* (pp. 131–146). MERGA.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Bravington, A., & King, N. (2019). Putting graphic elicitation into practice: Tools and typologies for the use of participant-led diagrams in qualitative research interviews. *Qualitative Research*, *19*(5), 506–523. http://doi.org/10.1177/1468794118781718

Charmaz, C. (2014). *Constructing Grounded Theory (2nd ed)*. SAGE Publications Ltd.

Corovic, E., & Downton, A. (2022). Resource materials as structured guidance in practice change. In. N. Fitzallen, C. Murphy, V. Hatisaru, & N. Maher (Eds.), *Mathematical confluences and journeys*. *Proceedings of the 44th annual conference of the Mathematics Education Research Group of Australasia* (pp. 154–161). MERGA.

Crilly, N., Blackwell, A., & Clarkson, P. (2006). Graphic elicitation: Using research diagrams as interview stimuli. *Qualitative Research*, *6*(3), 341–366. http://doi:10.1177/1468794106065007

Galletta, A. (2013). *Mastering the semi-structured interview and beyond: From research design to analysis and publication*. NYU Press.

Kervin, L., Vialle, W., Howard, S., Herrington, J., & Okely, T. (2016). *Research for educators (2nd ed)*. Cengage Learning Australia Pty Ltd.

Lewis, G. (2013). Emotion and disaffection with school mathematics. *Research in Mathematics Education*, *15*(1), 70–86. http://doi:10.1080/14794802.2012.756636

Murdoch, K., & Wilson, J. (2004). *Learning links: Strategic teaching for the learning-centred classroom*. Curriculum Corporation.

Palinkas, L.A., Horwitz, S.M., Green, C.A., Wisdom, J.P., Duan, N., Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm Policy Mental Health*, *42*(5), 533–44. doi:10.1007/s10488-013-0528-y