Designing for Children's Reflections in Collaborative Interaction Mediated by Technology: A Systematic Literature Review

Gökçe Elif Baykal[1], Olof Torgersson[2], Eva Eriksson[3]

[1] Department of Communication Design, Özyeğin University, 34794 Istanbul, Turkey
[2] Department of Computer Science and Engineering, Chalmers University of Technology and University of Gothenburg, 412 96 Gothenburg, Sweden
[3] School of Communication and Culture, Department of Digital Design and Information Studies, Aarhus University, 8000 Aarhus C, Denmark
elif.baykal@ozyegin.edu.tr

Abstract: Reflection is an integral part of collaborative interaction. However, we know little about how to design for reflection in collaborative activities mediated by technologies. This systematic literature review focuses on children's reflections within the collaborative practices in child-computer interaction research and investigates (1) the link between reflection and collaborative activities, (2) the types of collaborative technologies to scaffold reflection, and (3) the methodological approaches to analyze reflection. We searched the ACM Digital Library, Scopus and ProQuest which resulted in 141 papers that make the link between terms 'reflection' and 'collaboration' explicit, where only 13 of these involve children as the primary actors of reflection. The results show that this topic is increasingly gaining attention, however, the link between reflection and collaborative interaction remains underdeveloped. The contribution of this study is to provide a theoretical and methodological basis to understand, analyze and support children's reflections within a collaborative activity through technology.

Keywords: Reflection, reflective practice, collaboration, collaborative interaction, technology, design.

1 Introduction

Today, with the rise of emerging technologies such as AI and robots in education, children's reflective practices have gained much attention in the development and empowerment of becoming critical users, responsible designers of the future, and aware of the ethical concerns about technologies [9, 18, 37]. However, enhancements remain to be made in scaffolding children to achieve reflective thinking skills and critical sensitivities about

technology and design processes in education [50]. Deriving from the important role of reflection in learning [8, 12, 13, 45, 51], Engeström et al. [16-7] identified reflection as the most advanced level of collaborative interaction in a process of knowledge construction. He reformulated the social learning theory of Vygotsky in terms of interacting entities consisting of the actor as subject of an activity, the object and the community, and identified three levels of collaborative interaction (i.e., coordination, cooperation and reflective communication) to understand and analyze the social aspect of learning that goes beyond one's individual cognitive process [16-7]. In Engeström et al.'s identification, reflective communication refers to the transformative aspect of collaborative interaction where the actors revise and change their actions, rules, or routines of an activity. Engeström et al.'s identification has been applied in some HCI related work, e.g. [2, 4].

To our knowledge, there are two literature reviews conducted on designing for reflection in HCI (i.e., [20] and [3]). Baumer et al. [3] explored that most studies in the HCI literature rarely actually define reflection, and that the evaluations do not focus on reflection *per se*, but rather on some other outcome arguably linked to reflection. Fleck and Fitzpatrick [20] identified the levels of reflection that capture the behaviors and activities associated with reflective processes which according to them start with descriptive revisiting of events and lasts with a transformative practice where the information is used for change. However, in their review, the transformative aspect of reflection was found to be happening rather as internal processes, thus they did not include any specific technology examples for this final level. Baumer et al. [3] also found that most of the studies they reviewed in HCI dealt with reflection as an individual internal process whereas very few acknowledge it as a social activity, and they suggested studying social situations would provide opportunity for HCI researchers and designers to be able to observe and examine reflection where it is externalized. One area where children's reflection is found to be highly practiced and studied is within the computing, design and making in education, albeit not with a direct link to the collaborative activities [5]. In a recent case study, Slovák et al. [49] highlighted the social and emotional aspect of transformative reflection by focusing on the fundamental scaffolding role of mentors and facilitators rather than just triggers in the process of "reflection-in-action" (a term coined by Schön) by providing social support to students. To this extent, Engeström et al. and Slovák et al. shed light on the social and collaborative aspect of reflection and the transformative dimension that it adds onto learning and knowledge construction. However, how to scaffold children's reflective practices within a collaborative interaction through technology design is yet to be explored.

In this study, we put particular focus on designing for reflection in children's collaborative interactions mediated by technology. To better understand the interplay between reflection and collaboration in child-computer interaction research, as a sub-field of HCI, we aim to address the following research questions (RQ):

RQ1: How is reflection stimulated and evaluated in children's collaborative interactions mediated by technology?

RQ2: What are the types and roles of technologies to mediate children's reflections within collaborative activities?

RQ3: What are the methodological approaches and instances used in the studies to analyze and understand children's reflective practices within collaborative interactions?

The research questions are answered through a systematic literature review approach.

2 Method

This study is a qualitative systematic review that seeks for themes and constructs that lie in or across studies in relevant literature [24]. Our review focuses on the studies that deal with "reflection" in conjunction with "collaboration" and how these notions are jointly used within child-computer interaction research. The aim of this systematic literature review is to unfold and present the relation between these two concepts in research. To capture the most relevant studies, we delimited our search to find papers that have both terms in the descriptive metadata (title, abstract, or keywords). Our review process consists of three steps: 1. Data collection (searching the databases, extracting the papers), 2. Selection of the relevant papers and thorough elimination, 3. Data analysis and coding the selected papers. Two authors were responsible for the first step, and all authors were involved in the second and third step. Below we explain in detail how we executed the systematic literature review (see Figure 1).

2.1 Data Collection and Selection

We included ProQuest which provides access to other comprehensive databases of technology research, Scopus as Elsevier's database, and the ACM Digital Library, because these sources combine research across multiple disciplines in the human-computer interaction (HCI) field, and were therefore deemed most relevant for our review. We have excluded databases (e.g., Web of Science or Google Scholar) to operate a more focused search query and to capture the most relevant work. We did not limit the review to a specific time period, thus this study covers the publications available online until May 2020. The proceedings of the Interaction Design and Children conferences in 2012 and 2014 are not searchable in the ACM Digital Library, hence we reviewed these proceedings manually. Since we are interested in how children's reflection is dealt with in relation to collaboration mediated by technology, we applied the following inclusion and exclusion criteria to extract the most relevant papers:

1. To capture papers that uses the terms stem refle* and collab* in the descriptive metadata we used the following search query: (TITLE (collab* OR refle*) AND ABS (collab* AND refle* AND (technolog* OR design) AND (child OR children OR youth OR pupil)) AND ALL (collab* AND refle* AND (technolog* OR design) AND (child OR children OR youth OR pupil))). This step resulted in a total of 141 papers.

2. Among the extracted work, only full papers were included, while PhD theses, books, Work-in-Progress papers, and papers less than 3000 words were excluded. This step resulted in 134 papers.
3. For thorough elimination we also excluded papers in which children were not the main actors of the reflective practice. This step resulted in a total of 15 papers. Data analysis and coding of the selected papers; which resulted in excluding yet another two papers due to above mentioned criteria, ending up with 13 papers in total for thorough analysis (see Table 1) as described in detail below.

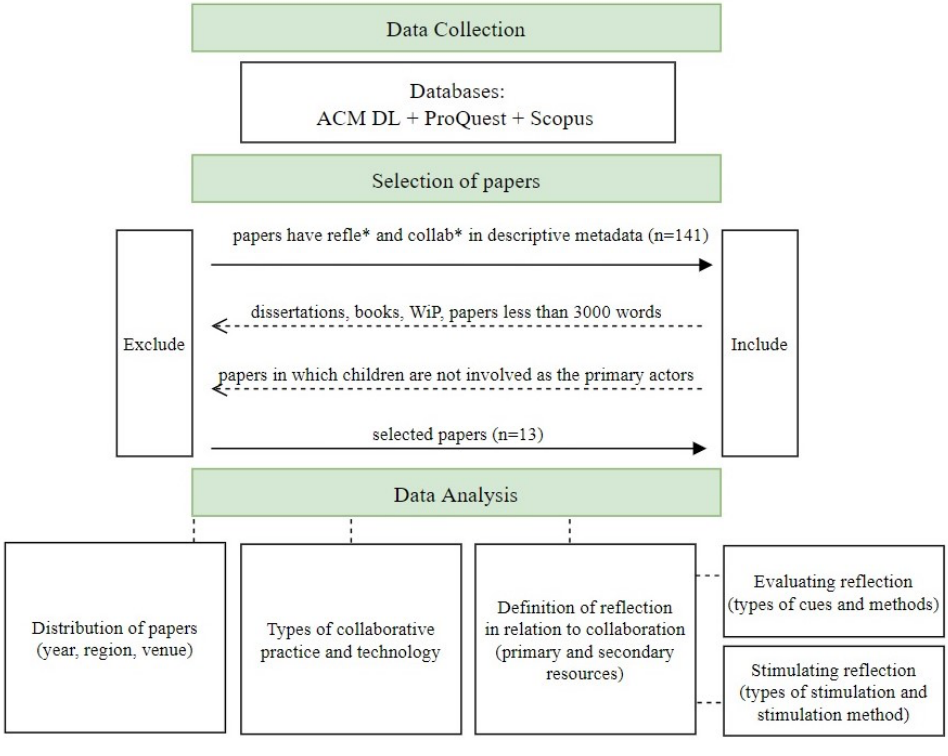

Fig. 1. Three-step process for systematic literature review: 1. Data collection, 2. Selection of papers, 3. Data analysis and coding.

2.2 Data Analysis

To analyze the selected papers, we conducted qualitative data analysis. The qualitative data included: 1) the distribution of papers per year, region and venue, 2) Definition or type of

reflection in relation to collaboration (if any presented), 3) How reflection was dealt with, evaluated, or stimulated in a collaborative interaction, 4) Types of collaborative practice that the reflection was concerned about, 5) Type and role of technology that mediated the reflection in a collaboration.

The remaining papers were scrutinized by three authors. To assure the reliability, the papers were reviewed and analyzed by the authors independently; the first author coded all the papers, and the other two authors each coded half of the papers, meaning that each paper was analyzed by two authors. Then we ran a consensus coding for the results where we had disagreed. After all authors had coded their part individually, we went through the coding in detail together and discussed how we understood and interpreted the data similarly and differently to calibrate internal consistency and reach a conclusion. Thus, instead of a statistical measurement for quantifying agreement, we achieved the inter-rater reliability through consensus coding in our qualitative data analysis.

We used both an inductive and deductive approach to formulate and synthesize the retrieved data, which is in line with our research questions. First, we started with an inductive analysis; scanning throughout the whole paper in keyword base using "refle*", read the paper thoroughly and copied the reflection-related content to an Excel spreadsheet. Then we discussed the forms and subject matters pertaining to the term "reflection" to generate the initial codes and organize the data in meaningful groups. When all authors agreed upon the coding, the content was analyzed under the relevant categories. The analysis was reiterated with a particular focus on the emerged categories (e.g., how reflection was scaffolded, what was the practice for reflection). The reiteration of data coding and analysis was conducted thoroughly by the first author in constant discussion and assistance with the co-authors. Below, the results extracted from the data analysis are presented in detail.

3 Results

3.1 Reviewed Papers: Distribution per Year, Age Range and Collaborators

From the 13 papers, 11 were published in the last ten years, and eight were published between 2017 and May 2020 (see Table 1). This suggests that investigating children's reflective practices within a collaborative interaction mediated by technology is gaining attention, however the integral role of reflective aspects within collaborative practices is a rather new phenomenon in the literature. When it comes to the target age in the studies (see Table 1), children between 9 and 14 years old are the most represented age group [6, 10, 27, 30, 33, 47, 48, 52]. Children younger than 9 years old were relatively less studied [21, 25, 43]. Interestingly, children above 15 years of age were only found in one paper [19]. Yet, the target age range across the studies shows the wide array of interest in researching reflective practices varying from preschoolers to higher education. When looking at the

collaborators, an extensive number of the reviewed papers (11 papers) recruited children as peers in the collaborative activity. In two papers the collaborative interaction took place among inter-generational groups (e.g., family members [43], members of a choir [6]). Furthermore, in [25] a robot was utilized as a tutee in children's collaborative learning by teaching activity. The majority of the collaborative activities were studied or carried out in a school context (11 papers), and with co-located participants (12 papers).

Table 1. Overview of the 13 included papers according to publication year, technology, age of the participating children, and types of collaborative activities and instances of technology that mediate the reflective practices among children.

YEAR	REFERENCE	TECHNOLOGY	INSTANCE	AGE	ACTIVITY
1998	Loh et al [33]	Online	Progress Portfolio tool	11-13	Science learning
2008	Ching & Kafai [10]	Online	Logo Microworlds	9-10	Learning-through - design
2011	Jamil et al [27]	Touch	Tabletop	11-13	Science learning
2013	Shimoda et al [47]	Online	Web of Inquiry	10-13	Science learning
2015	Kafai & Vasudevan [29]	Maker	Makey Makey, Scratch	13-15	Game design
2017	Saksono & Parker [43]	Paper	Storybook	3-9	Physical Activity tracking
	Wise et al [52]	Touch	Tangible Tabletop	10-11	Gameplay
2018	Zhang et al [54]	Paper	Workbook	11-13	Design-based learning
	Fridberg et al [21]	Touch	Tablets	3-6	Science learning
	Belgrave & Keown [6]	Online	Dropbox	9-14	File sharing
2019	Hamamsy et al [25]	Robot	Nao robot	7-8	Co-writing
	Eshuis et al [19]	Online	CSCL environment	17	Vocational training
2020	Sinervo et al [48]	Maker Paper	Lego robotics, GoGo board, reflective journals	11-13	Co-invention

3.2 Collaborative Interaction: Type of Collaboration and Mediating Technology

The collaborative activities in which the reflection took place in the studies were mainly design-based activities such as learning-through design using Logo Microworlds programming [10], game design with MaKey MaKey, Scratch and boardgames [29], co-invention activity with Lego robotics, GoGo boards and collaborative paper-based reflective journals, design-based learning and filling out a collaborative workbook as a guidance for activities [54], science learning activities such as science learning through a software tool (e.g., Web of Inquiry [47], Progress Portfolio [33], CSCL environment [19]), interactive surface (e.g., tablet [21], tabletop [27]), or co-writing activity tutoring a Nao robot [25], and other activities which could also be identified as leisure activities such as inter-generational file sharing between members of a distance choir [6], gameplay on a tangible tabletop application [52], or tracking physical activity and health attitude [43]. However, these activities are not mutually exclusive from each other; the design activities conducted in studies are mostly related to design-based learning and took place in a school context. The instances indicate the type of technologies that the reflective practices mediated within the collaborative interaction which fall under five broad categories: online software or tools [6, 10, 19, 33, 47], touch-based surfaces [21, 27, 52], hands-on tools for maker programming [29, 48], paper-based design tools [48, 54], and robots [25] (see Table 1).

3.3 Reflection in Collaborative Interaction: Definition

The term reflection was inadequately defined in the reviewed papers in general, yet we found six papers that described how they conceptualized and approached children's reflection in their studies. We found the following terms derived from reflection i.e., *reflection-in-action*, *self-* and/or *joint-reflection*, and *reflective inquiry* applied in children's collaborative practices as presented respectively below.

Zhang et al. [54] strived for incorporating children's *reflection-in-action* into design-based learning (DBL) processes by solving real world problems through hands-on design activities. As a term, reflection-in-action was coined by Schön whose theory of reflection is based on understanding the learning through doing process. Schön [45] illustrates reflection-in-action as an individual and cognitive process of knowledge acquisition and restructuring in the midst of an action. Schön's term has been carried further by Zhang et al. [54] in a context where children engaged in design activities with a coordinated effort shared and constructed knowledge. Thus, they showed that reflection-in-action could also happen during a collaborative practice. Based on observations of children's collaborative DBL activities, Zhang et al. [54] identified four observable characteristics of reflective discourse that define reflection-in-action: 1. "surprising event" that leads to a breakdown

and the discourse refers to the emerging topic of the group's reflective discourse, 2. "knowing-in-action" - a contextual content that collaborators shared in the group to appreciate the surprising event information used for reflecting, 3. "improvisation to respond to surprise" - responding to a surprising event through the audible or visual artefacts they created, 4. "effects on ongoing action" - exploring an information space associated with the activity which lead to an immediate effect on the action. Investigating children's reflective discourses in this study showed that children tried to understand the uncertain situation. While doing so, children shared their appreciation with the other group members, modified their action on-the-spot if needed, and developed a new understanding of a subject matter through group effort [54].

In [19, 25, 47], reflection was described in the form of self-assessment or *self-reflection* to promote children in monitoring and evaluating their own learning process and obtain metacognitive skills in understanding their own progress. These studies focused on how children's self-reflection and/or *joint-reflection* prompted by a system aimed at fostering their collaborative inquiries. In Eshuis et al. [19], reflection was delineated as looking back on past behavior in order to improve future behavior that leads to knowledge acquisition in vocational students aged around 17 years old. Thus, students' reflection was carried out through self- and peer-assessment where they thought critically about an experience to advance their domain knowledge. Jamil et al. [27] categorized reflection as one out of eight utterance types (i.e., group identification, interdependence, directives, social organization, tasks, reflection, interaction methods, playfulness) to analyze a collaborative conversation among children 11-13 years old. In their categorization, children's utterances related to a broader discussion of the learning topic were labeled as reflection [27].

The earliest study among the reviewed papers identified *reflective inquiry* as a fundamental practice for learners to be successful with computer tools [33]. Becoming a better inquirer meant that being able to reflect on their mistakes and realizing the dead-ends in their investigative paths. To improve this practice, students need to think and talk about the process of their investigation activities through constant reasoning and justifying the decisions. The authors identified three key skill sets needed for being a better reflective inquirer that need to be developed in children: 1. Documenting inquiry actions and understandings while working (e.g., decisions in inquiry, changes in understandings, and data-gathering strategies). 2. Organizing and making sense of these documented elements of inquiry which provide an important opportunity for reflection in making decisions (e.g. how to group data items, what relation a particular artifact has to an investigation, and how to name or where to store an item) requires students to step back from their immediate work and reflect on their purpose, and negotiating these management decisions with collaborators requires additional reflection on the relative merit of a variety of ideas about managing information. 3. Describing inquiry processes and products as students present their report. Loh et al. also pointed out that reflective inquiry enables a highly collaborative process when students take on different roles as they collaborate around the computer, such as while some are doing the data gathering, others concentrate on documenting and presenting the results [33].

To have a stronger grasp of what is meant by the definition of reflection as a term, we present the definitions found in the secondary resources referenced in the reviewed studies below.

Definitions of reflection in secondary resources referenced in the reviewed literature. The definition of reflection is not adequately presented in the reviewed papers. Thus, to provide an in-depth glimpse into the conceptualization of the term we reviewed the secondary resources that the reviewed papers referenced in their studies for understanding the role of reflection in a collaborative activity. As explained above, Zhang et al. based their work on reflection-in-action, a term coined by Schön that illustrates the process of knowledge acquisition and restructuring when people reflect in the midst of action ([45] in [54]). They also reviewed related work that adopted Schön's theory. They referred to four studies [1, 23, 32, 53] that further developed Schön's framing of the term. For instance, Arias et al. had described the term as a process with putting a particular focus on the experience of breakdown situations that create an information space related to people's actions and that people reflect upon those activities ([1] in [54]). Later, Yanow and Tsoukas took the breakdown situations one step further and identified three types of surprise events (i.e., malfunction, temporary breakdown, and total breakdown). These different types refer to the level of effort required for addressing the surprise event that the reflection is concerned with ([53] in [54]). Levina took Schön's term to a collective level and examined peers' reflection-in-action by looking at collaborators' sharing of their views through audio and visual artifacts ([32] in [54]). Gourlet et al. intended to offer a research diary as a design tool for children. Using the diary not only helped children significantly report more on the reflection-in-action moments during design activities, but also encouraged them to modify their products on the spot and discuss new possibilities of their projects within groups ([23] in [54]).

Table 2. Methods for evaluation of reflection in children.

Type of Cues	Evaluation Method
Verbal	utterances [21, 27, 54] chat logs [19, 47]
Non-Verbal	peer help [10] behavioral and emotional engagement [25] physical interaction and enjoyment [43] documentation [33]

Among the reviewed papers, Eshuis et al. relied heavily on the "joint reflection" concept and they presented an extensive overview of findings related to this concept as a grounding for their work [19]. They referred to Quinton and Smallbone in defining reflection as "a

mental process that incorporates critical thought about an experience and demonstrates learning that can be taken forward" ([39] in [19]). They referenced to Gabelica et al. and Prinsen et al. to support the view of the role of reflection in learning within a collaborative setting, and reflection is part of collaborative skills ([22, 38] in [19]). Furthermore, they also referenced to Renner et al. who suggested joint reflection is more effective than independent reflection ([40] in [19]). In parallel to this, studies have shown that joint reflection which combines self and peer-assessment provides a better basis for learning, perceived group-process satisfaction and social performance, and collaborative activity sets a promising stage for the reflective practice ([14, 28, 35, 36] in [19]). However, Eshuis et al. also emphasized the ambiguity in the existing work due to the fact that reflection on collaboration was implemented differently in the different studies and collaboration was measured in different ways. Thus, they briefly inferred that studying reflection ideally involves students to assess their own performance by comparing their performance to the goal performance, identifying gaps in their performance, and working towards fixing these gaps as suggested in ([39, 42, 46] in [19]). Yet, Eshuis et al. also pointed out that this reflection through self-assessment approach has its own drawback in that students were found to overestimate their own skills and performance (e.g., [15]), which also causes them to fail to identify gaps in their skills, and put less effort than needed to accommodate their behavior regarding collaboration skills (e.g., [35, 36]). Furthermore, an external agent or support is a necessary precondition for children to perform reflection [22]. Reflection also requires students to compare their performance to the goal performance, identify gaps, and make a plan to work towards fixing those gaps (see, [39, 42, 46]). Thus, Eshuis et al. laid the basis on the view that reflection should not only be about students' current behavior, but should also include their future functioning ([22, 36, 39] in [19]).

Definitions for reflection were scarce, but the descriptions presented above illustrate how the studies approached children's reflective practices within a collaborative interaction mediated by technology. This also aligns with the findings for evaluation criteria in the reviewed literature, in that all papers which offered a description of reflection, also have evaluated reflection in their studies. The set of evaluation criteria found in the reviewed literature are described in detail in the following section.

3.4 Methodological Approaches to Children's Reflection: Evaluation of Reflection

In the reviewed studies, we found two categories for the use of reflection in evaluation: (1) Evaluation of reflection in children either focusing on their reflective communication or factors that support their reflective practices within a collaborative interaction, and (2) Evaluation of a collaborative tool or a system design by looking at children's reflections. While the former instances inform us more about the possible set of criteria for evaluating children's reflections, the latter shed light on various types of reflections (e.g., virtual exchanges) possible through technology design.

Evaluation of reflection in children. Among all the reviewed papers, nine of them [10, 19, 21, 25, 27, 33, 43, 47, 54] measured or evaluated children's reflection in a collaborative interaction, or made an analysis of factors that play a role in children's reflection. Reflection was investigated through analysis of children's (a) verbal communication such as reflective discourses or utterances [21, 27, 54] in face-to-face interaction or online conversation through chat logs [19, 47], (b) non-verbal interactions through behavioral and emotional engagement [25], peer help [10], physical interaction and enjoyment [43], or documentation of classroom activities including collaboration and teacher facilitation [33], (see Table 2).

Evaluating reflection through verbal interaction. For exploring reflection within verbal communication in face-to-face interaction, [21, 27, 54] conducted discourse or utterance analysis. Zhang et al. [54] examined children's (ages 11-13) on-the-spot reflections while dealing with an ill-defined design challenge in group work. Following a bottom-up approach, they analyzed children's verbalizations in different phases and identified six types of reflective discourses that affect group behaviors: 1) articulating opinion in a debate to clarify an uncertainty, 2) becoming aware of skill deficiencies and developing strategies to overcome, 3) reviewing and rediscovering design task requirements and detecting the deviating actions, 4) paying attention to a group member's distraction and maintaining team equity, 5) recognizing the importance of documentation of ideas during the collaborative work, 6) acknowledging the progress.

Referring to what Schön describes as "immediate significance for action", the authors suggested that these discourse types indicate the various ways in which the collaborative aspect of the reflection contributes to the group work process (i.e., a group repair action in type 1, 3 and 4, an improvement action that children explore in the context to find a way to optimize their way of doing design tasks in type 2 and 5, or an increase of positive emotions in the group in type 6) [54].

Fridberg et al. [21] investigated the potential of tablets to support preschoolers' (ages 3-6) reflective thinking in collaborative science learning activities. They evaluated children's reflection with respect to their focus of attention. They also followed a bottom-up approach in their analysis and reported six contexts concerning children's reflective statements about a science phenomenon: 1) Synthesizing reflections that involve more than one aspect of the phenomenon, 2) Bringing hypothesis concerning process about the phenomenon, 3) practical aspects of the experience, 4) describing related concepts, 5) other statements e.g., "don't know", 6) statements about the setup. The researchers then analyzed these categories quantitatively with their prevalence to four different collaborative learning contexts (i.e., group discussion, stimulated recall, content production, experimentation) [21]. Similarly, Jamil et al. investigated children's (ages 11-13) conversational patterns across three different conditions of table-based interactions (i.e., direct touch, pantograph, and non-digital). They quantitatively analyzed children's reflective utterances as a unit of speech as part of peer collaborative learning that relate to social interactions such as group coordination, group cohesiveness, topic-based discussions and off-topic based discussions. Their findings showed that non-digital tables promoted reflective forms of task-orientated

utterances, encouraged group communication and fostered more equitable participation. The study provided insights into the design of interactive tables to support particular forms of social interaction [27].

Reflections in remote interaction were studied via chat logs in [19, 47]. Shimoda et al. [47] developed a web-based system to support self-reflection in science learning through collaborative discourse. Their system seamlessly integrated a reflective assessment tool to track and scaffold students (ages 10-13) active reflection throughout the project to document their inquiry process as well as to think about and discuss their own work. This study showed the importance of reflection and peer feedback as part of collaborative science learning practice. To evaluate the effect of joint reflection in vocational students' knowledge acquisition, Eshuis et al. compared joint reflection that include self and peer assessment to only instruction-based and no instruction conditions for learning [19]. The researchers adopted an a priori measurement tool namely RIDE rules (i.e., Respect, Intelligent collaboration, Deciding together, and Encouraging) developed by Saab et al. [41]. The evaluations also included whether students kept each other posted, helped each other when necessary (i.e., whether they shared information, asked questions, and were critical regarding others' input), and whether they took responsibility for their actions and decisions. Their study showed that students from the joint reflection condition outperformed the other students in their collaborative behavior and domain knowledge gains, and strongly links to effective collaborative learning in computer supported collaborative learning environments [19].

Evaluating reflection through non-verbal interaction. Reflection was also investigated through children's non-verbal interactions such as behavioral and emotional engagement [25], peer help [10], physical interaction and enjoyment [43], or documentation [33]. Hamamsy et al. [25] designed a collaborative learning activity that involves children (ages 7-8) in teaching handwriting to a Nao robot through probing social engagement strategies. They evaluated children's reflective practices with respect to their activity and group interactions in their collaborative task behavior (behavioral engagement), satisfaction (emotional engagement) and performance (cognitive engagement) [25]. Ching and Kafai [10] examined the effective collaborative learning patterns of students (4th-5th graders) in computer-based simulation design activities with particular focus on the reflective interactions. They followed a hermeneutic methodology and documented various kinds of peer-to-peer helping (help-giving and help-receiving in an apprenticeship) as well as tracing trajectories of the flow of collaborative interaction in a descriptive flowchart of the progression of helping practices in different episodes. They presented an emergent framework that illustrate the supporting patterns within teamwork. They proposed the term "peer pedagogy" to describe the complex interactions and assess the strategic, reflective and effective nature of peer helping in team interactions with experienced members [10]. Saksono and Parker [43] examined children's (ages 3-9) reflective information scaffolded and prompted by a story-driven interactive tool to encourage their physical activity and health-related critical processes for behavior change. In doing so, they evaluated the factors

in the stories that initiated self-efficacy reflections on physical activity enjoyment. Their approach to evaluation of reflection do not only provide support for meaningful insights into designing reflective probes but also broadens the perspective for understanding the role of joint reflection [43]. Loh et al.'s [33] approach in using reflective inquiry (i.e., documenting, organizing, and presenting the inquiry process) as an evaluation method is another example for understanding the non-verbal aspects of reflective practices in collaborative learning environments.

Table 3. Methods for stimulating reflection in children.

Type of Stimulation	Stimulation Method
Implemented prompts	creating situations for reflection [25, 27, 43, 52] reflective assessments [19, 47]
Scaffolding techniques	Interviews [10, 29] reflective essays [48] journals [6] annotated portfolios [33]

Evaluation of a collaborative tool or a system design by looking at children's reflections. In our review we also found three studies that examine children's reflections to evaluate the collaborative possibilities offered by technology [6, 29, 48]. Sinervo et al. [48] studied the potential of digital and traditional fabrication technologies used in open-ended co-invention projects in elementary school children (ages 11-13) throughout two years. Children were asked to reflect on their team's co-invention process by characterizing the properties of it, describe the progress of their collaboration during co-invention, and describe the quality of their team collaboration. By doing this, the researchers evaluated and discussed the underlying factors including values and motivations and the major difficulties that concerned children in the co-invention processes. Similarly, Belgrave and Keown [6] collected open-ended responses from their participants across different generations reflecting on their expectations in their collaborative experiences in online music therapy programs, their personal preconceived notions about the other generation, and enjoyable factors related to the other generation singers and the inter-generational collaboration process. The study reported that these reflections helped to improve the cross-age attitudes and interactions during the project. Lastly, Kafai and Vasudevan [29] focused on the analysis of high school students' overall reflections on how they conceptualized game elements (i.e., choice of theme, work distribution, and audience consideration), realized computational concepts and practices in their board game designs, and reflected on their game design experience. In doing so, they explored and discussed the opportunities for design workshops on high- and low-tech games connecting on-screen programming with hands-on crafting.

3.5 Methodological Approaches to Children's Reflection: Stimulation of Reflection

In the reviewed papers, 12 of them (see Table 3) clearly described how they stimulated reflection in children. We found mainly two forms of stimulation for reflection in the reviewed studies: (1) Reflective prompts implemented in the collaborative technology i.e., creating situations for reflection [25, 27, 43, 52], or reflective assessments [19, 47], (2) Methodological tools or techniques to scaffold reflection in children i.e., conducting interviews [10, 29], gathering reflective essays [48], journals [6], collaborative workbooks [54], or annotated portfolios [33] from children (Table 3).

Reflective prompts implemented in the collaborative technology. There are two forms of reflective prompts used in the studies which we namely categorized as creating situations for reflections and reflective assessments as described below.

Creating situations for reflection. Creating situations for children's reflective practices through engagement [25], roles in gameplay [52], gamified hands-on cues [43], tabletop interaction techniques [27].

Hamamsy et al. [25] perceived reflection as an integral part of collaborative learning and as a key to children's emotional, behavioral and cognitive engagement in collaborative activities. Thus, they seamlessly integrated self-reflection to aid children's (ages 7-8) collaborative tasks. In their study, children are encouraged to engage in a handwriting activity through teaching collaboratively to a robot, and reflect on the robot's performance and by extension their own, and on their emotions with respect to the activity and group interactions. To stimulate reflection, the robot asks for feedback to have children meta-cognitively reflect on what is going on, and inherently lead their engagement; emotionally they feel like their opinion matters, cognitively they have to reflect on the question, and behaviorally they are required to respond in order to pursue the activity [25]. This study is an exemplar in which reflection is stimulated in children as an engagement strategy in design for collaborative learning.

Wise et al. [52] investigated and compared the characteristics of verbal exchanges among pairs of children (ages 10-11) while playing tabletop games with and without assigned roles (e.g., resource management) and controls. They found that both conditions triggered retrospective (e.g., what could have been done) and positive feedback, however the roles condition in games also stimulated more action-oriented prospective reflections (e.g., what would work better) on the game state than the non-roles condition [52]. Thus, this study showed that game elements such as roles in gameplay might offer possibilities for children to reflect on various temporalities of the game state which is not only limited with the past and existing situation but thinking strategically further steps ahead.

Saksono and Parker [43] designed animal stickers, acting as cues for reflection within a storytelling context, that are easily accessible for children (3-9 years old). Children reflected on their emotions about physical actions (PA) in answering questions such as "Can you remember a time when you felt scared to jump into a pool?" [43]. These reflective prompts

not only helped to scaffold reflection in children about their self-efficacy in physical activities, but also created a gamified language that help children to think and articulate about their behaviors and shape their PA behavior change.

Jamil et al. [27] compared three different forms of table-based interaction (direct touch, pantograph, and non-digital) and two different types of collaborative learning activities: 1. Spider diagrams similar to a mind map whereby a topic is investigated and explored by visualizing associations and relationships between related key concepts, and 2. Classification tasks. They compared the interaction capabilities of these tables with respect to what extent they support and scaffold reflection in children (ages 11-13). Their study showed significant differences between non-digital and both direct touch and pantograph table in terms of favoring the former in its richer potential to stimulate children more to talk and discuss task-related aspects of the topic and involve in general reflections expanding their learning-related conversation. The researchers concluded with design insights to develop tabletop interaction techniques in service of children's collaborative learning [27].

Reflective assessments. Another way of integrating reflective practice into collaborative interaction is to design reflective assessments through questions or feedback models to scaffold children's reflections on their own metacognitive activities [47] or performances [19].

Shimoda et al. [47] designed reflective questions and implemented them in their web-based system. The questions (e.g., "Could it be better? Could it be clearer? Could it have more reasons why?") were posed by the teacher to stimulate students to go back and reflect on their own work. The teacher further provides prompts such as "Some of the things our group thinks we may need help with are..." to encourage students to begin to delve deeper into their self-assessments and think about why they did not rate themselves highly [47].

Eshuis et al. [19] designed a feedback model integrated into an online tool to help vocational students' joint reflection on their collaborative behavior. In line with the model proposed by Hattie and Timperley [26], the feedback model incorporated principles of self- and peer-assessment and goal setting. The individual part included: 1. feed up – rating their own and each other's collaborative behavior on a ten-point scale, and 2. feed back - comparing their performance to the goal performance. In the group part the students provided feedback in collaboration with the other team members 3. feed forward - identify gaps in their performance and work towards fixing these gaps. In each phase students discussed what went well and what could be improved, after which they had to write down their joint goals (i.e., what will they keep on doing? and what to improve?). This feedback model was inspired from the major steps in reflection such as identifying gaps in their performance and working towards fixing these gaps (e.g., in [39], [42], and [46]), and improving their collaborative behavior and domain knowledge acquisition [19].

Methods to scaffold reflection in children. In six studies we found that the reflection in children was stimulated as part of the data collection methodology such as interviews [10,

29], reflective essays [48], journals [6], workbooks [54], or progress portfolios [33]. Below we describe these tools and techniques utilized to scaffold children's reflections.

Interviews. To stimulate reflection in children, interviews were conducted with predefined questions [10], or in focus groups [29]. Ching and Kafai [10] asked children questions in seemingly vague manner rather than focusing on specific issues (e.g., "Can you think of any differences between fourth-graders and fifth-graders in terms of how they worked on the simulation design project? What are they?", or "What does it mean to be a fourth-grader working on this simulation design project?"). The purpose was to find out what skills and practices children would spontaneously mention when considering the nature of their experiences in learning-through-design activities with each other. According to the authors, the choice here was to ask students to reflect not on skills or competencies in the abstract, but rather inciting children to unfold the different ways of knowing and doing in the design project [10].

After a game design workshop with hands on programming tools, Kafai and Vasudevan [29] conducted focus group reflections to understand how children interpreted the game design process and navigated coding and making [29]. They thematically analyzed the statements extracted in focus group interviews and pointed out the key considerations of youth, such as how game making activities promote (or not) programming activities, building awareness of the audience in the design process, drawing on their personal interests and source of inspirations (e.g., music, movies, and video games) that influenced their game design choices [29]. As can be seen from these two examples, the interviews to stimulate children's reflections followed a rather open-ended fashion to let children be able to articulate their views from a broader perspective.

Reflective essays, journals, workbook, or progress portfolio. Encouraging children to report their experiences in written documents such as reflective essays [48], journals [6], and collaborative workbooks [54] was found to be a common technique to retrieve children's reflections. However, in order to avoid one member assumed responsibility of writing it in a collaborative process, Sinervo et al. [48] asked students to report to describe the division of labor during the co-design session (i.e., who did what) in the project essay. Children were also asked to describe how the work proceeded, and reflect on the nature of their collaboration during the design and making process, by adding some photos to the essay folder. Thus, every pupil wrote their reflections about the development of the co-inventions in the middle of the project. To help children structure their essay writing the researchers provided four open-ended questions. The instructions were adapted from Barlex's model [11], that consists of the following aspects: need for (i.e., why is it needed?), use or function (what is it used for?); technical (how does it work?), appearance (how does it look?), structure (what parts does it consist of, and how do the parts fit in?) and user (who is it designed for?). These questions helped pupils to describe and reflect not only upon their work but also how their co-invention had progressed [48].

Belgrave and Keown [6] asked their participants across different ages to keep journals to reflect upon intergenerational experiences in their collaboration. They provided questions as scaffolds (e.g., what did you think of the older adults/children in the video?; what do you look forward to in collaborating with the older adults/children?; what are you unsure about in collaborating with older adults/children?). In Zhang et al. [54] and Loh et al. [33], we encounter examples of that the set-up work as a method for stimulating the reflective practices, such as giving an ill-defined design task that relates to everyday problems [54], ask children to document their process in a collaborative workbook, or asking students to create progress portfolios annotating their own inquiry- based learning process [33].

4 Discussion

This systematic literature review focuses on children's reflective practices within collaborative interaction mediated by technology. It builds on previous studies that address how technology should be designed to support people's reflection in HCI [44], but did not have a specific focus on children [3, 20]. The review is based on 13 papers out of 141 papers retrieved from ProQuest, Scopus and the ACM Digital Library. The study addressed the meaning and the role of children's reflection in collaboration, how it is practiced, evaluated, and scaffolded through technology. To investigate the close link between reflection and collaboration, we delimited our scope to papers that have both of these terms in their descriptive metadata (title, abstract, or keywords) as a starting point. The rationale behind this purposive sampling in this qualitative systematic literature review was grounded in the relation between the concepts of reflection and collaborative interaction found in Activity Theory [e.g., 16-7], and the motivation was to broaden the understanding of a particular phenomenon in the child-computer interaction field.

Among the reviewed papers, we found that there are many studies that investigate reflective practices in collaborative interaction which serve children, however, it is striking that in an extensive amount of these studies (120 out of 141 papers), reflection is not practiced by children, but rather by adults (e.g., teachers, caregivers, other stakeholders). Thus, there is a need for research in which children are the main actors of the reflective practice within a collaboration mediated by technology. However, our search results also showed that there is an increasing interest in this scope of research, significantly raising in number since 2017. This could be a result of increasing attention for developing technologies for supporting children's collaborative interactions and recognizing reflection to be an integral part of design and collaborative activities. However, there is still a lack of a concrete definition for reflection in collaboration. Studies mostly relied on related terms such as "*reflection-in-action*", "*self- and/or joint-reflection*", "*reflective inquiry*" which make reflection being studied in different forms and leave the theoretical grounding of the term less solid. Lack of a clear definition for the concept of reflection in HCI has also been found in [3, 20]. Though, Baumer et al. [3] presented this finding less as a critique and more as an opportunity for engaging with diverse theoretical literature on reflection rather than

rigid prescribed frameworks. While acknowledging the liberating aspect of diverse theoretical literature, we found yet very little reference to the existing literature in the reviewed papers. Moreover, the lack of a concrete definition leads to scattered evaluation criteria for reflection in the studies, which we discuss in more detail below. However, one of the main contributions of this study in relation to related literature reviews in HCI, is that despite the prevalence of reflective practices within collaborative interaction mediated by technology, it is seldom explicit in the children's reflections.

With this study, we further extracted different ways of evaluating and stimulating reflection in children's collaboration. We found two forms of evaluation in which reflection was examined; reflection was 1) evaluated in children either focusing on their reflective communication or factors that support their reflective practices within a collaborative interaction (e.g., [10, 19, 21, 25, 27, 33, 43, 47, 54]), or 2) used as a variable to evaluate a collaborative tool (e.g., [6, 29, 48]). These instances provide us some insights about how to grasp the term and formulate the reflective practice within children's collaboration. However, these insights are limited with indicating that reflection is a practice which depends highly on the human factors. Thus, how to develop collaborative technologies to support children's reflection and implement scaffolding features are yet to be explored. Also, this finding goes in parallel with Baumer et al.'s [3], showing that the majority of studies dealt with reflection as the means to an end, whereas very few evaluations focus on reflection as such, and instead assesses outcomes supposedly resulting from reflection.

In addition, we could not find recurring approaches to stimulate reflection in children's collaboration mediated by technology. However, all the reviewed papers except one have clearly addressed a tool or a technique that describe how they stimulated or encouraged children to reflect within the collaborative interaction. Since these findings for stimulation were quite scattered, we identified the methodological approaches mainly in two broad categories; 1) reflective prompts integrated in the technology design (e.g., roles [52] or hands-on cues [43] in a gameplay, or incorporating reflective assessment through questions and feedback models), or 2) methods such as interviews [10, 29], or tools such as reflective essays [48], journals [6], and collaborative workbooks [54]. These scattered stimulation techniques along with the lack of concrete definitions and the diverse evaluation approaches make it quite difficult to compare studies and to make proper judgments of which technologies actually scaffold and enhance reflective practices among children within collaborative interactions. This is all the more important since the majority of the reviewed papers target educational contexts. We therefore encourage designers and researchers in HCI to develop and validate theoretical frameworks and tools to design and evaluate children's reflective practices when interacting through collaborative technologies.

Another interesting point from our findings is that the concept of reflection remains on the level of evaluating the understanding of an activity or experience. However, as described by Dewey reflective thinking as a process involves a deeper consideration of experiences and actions which is not limited simply to a sequence of ideas but rather extends to grasping consecutive order of actions, experiences and ideas for meaning-making [13, 44]. He further pointed out that reflective thinking does not only appear through experiences with the artifacts but also in interactions between oneself and other people [13]. This also

aligns with how Engeström et al. [17] formulated reflective communication between people. In his view, reflective communication is the most advanced level of collaborative interaction in which people redefine their objective, reformulate the rules and routines, and reconceptualize their roles if needed. Thus, for Engeström, reflective communication provokes, invites and enables people to change or rethink their practices either with the artifacts or each other, and thus cultivates the transformative aspect of a collaborative interaction. However, the transformative aspect of reflective practice as such has not been dealt with thoroughly in children's collaborative interactions in the reviewed literature. As also emphasized by Baumer et al. [3], a nuanced understanding of reflection itself is necessary to grasp the means of assessing and supporting it. To that extent, we suggest examining and unpacking the transformative nature of reflective practices may be a starting point.

5 Conclusion and Future Directions

Our systematic literature review addresses how HCI research involving children used the term reflection in relation to collaborative interaction mediated by technology. Based on this systematic literature review, we provide the following take-away messages and future directions for further research on children's reflections linked to their collaborative practices mediated by technology:

Studies that examine children as the main actors of reflection are scarce. Studies that concerned and investigated the factors that involve children's reflection in a collaborative practice mediated by technology are very few in the reviewed papers. Moreover, studies that involve children between 14-18 years old are lacking. Thus, we suggest that further investigation for this age group would be meaningful. Given the rise of emergent technologies such as AI, social robots, or social media algorithms, that surround the everyday life of children in different contexts, supporting their reflective and critical thinking towards the existing technology and developing their reflective mindset towards technology design gain a particular importance. Collaborative activities that involve children to communicate reflectively may be a powerful way to empower them to reconsider, change or transform their practices with emergent technologies.

Reflection in collaborative interaction is inadequately defined. The term reflection has been scarcely defined in the reviewed literature, let alone conceptualization of its role within a collaborative interaction. Mostly related terms e.g., "reflection-in-action" coined by Schön [45] as found in [33, 54], "joint reflection" as found in [19] laid the theoretical basis the reviewed studies. Reviewing the definitions found in the secondary resources in [19, 54] also aligns with this position. A literature review based on snowballing may be a way to delve into how to formulate and explore the identifying factors for reflective practices in

collaborative interactions. Besides, as found in [3], the theoretical literature on reflection and reflective thought is diverse and rich (e.g., see, [7, 12, 13, 31, 34] in HCI studies. Thus, exploring the vast amount of literature on reflection and reflective thought that goes beyond Schön may also expand and enrich the theoretical grounding of the term and benefit in opening up different ways of designing for reflection in children's collaborative practices mediated by technology.

The transformative aspect of reflection within a collaboration bears a strong potential for investigation. Even though very few studies touched upon the transformative aspect of reflection, some findings indicate that reflective practice relate not only to critical thinking about a past or existing action, but also contemplate about how to take an action forward (e.g., [19, 39, 45, 52, 54]). Prospective thinking as well as retrospective thinking (e.g., [52]), becoming aware of the consequences of an activity (e.g., [54]), and encouraging children to plan for further steps, as suggested by [19] instantiate the transformative role of reflection within a collaborative interaction. Furthermore, as found in the secondary resources, creating breakdown situations might be a way to scaffold and examine the transformative behavior in children (see, [1] in [54]). Thus, we think investigating and elaborating more on this aspect offer a promising path for future research.
Design guidelines for scaffolding reflective practices mediated by technology are few and scattered. Given the varied definitions along with scattered evaluation criteria and stimulating methods found in the reviewed literature, we still lack a solid background about how to design technology to support children's reflections. Most of the studies dealt with the reflection inherently occurring in children's practices, thus the child-computer interaction field would benefit from more empirical research on developing design guidelines for scaffolding children's reflections in different platforms for collaborative activities. Furthermore, methodological contributions such as evaluating different types of stimuli for reflection (e.g., scaffolding techniques and implemented prompts) would be helpful in creating knowledge about design method applications, new measures, or new instruments that can be considered for studies on this topic.

Lack of research in reflection within remote collaboration. Since this paper is being written in the pandemic situation caused by the Covid-19 outbreak, the number of studies found in this review which were carried out in a school context and with co-located participants (exception with the choir in [6]) is noteworthy. Thus, it is important to highlight that there is a gap in research which examine tools to mediate children's collaborative and reflective practices in remote collaboration.

Last but not least, an important limitation of this literature review is that we only relied on the words stemming from technology and design and having both terms stemming refle* and collab* in the descriptive metadata. Hence, we may have missed relevant papers using other terms such as media, system, platform, groupware, or device, that also deal with reflection in collaborative practices albeit not explicitly stated in the descriptive metadata. In spite of these limitations, this literature review covered three comprehensive databases

ACM Digital Library, ProQuest, and Scopus which accommodate relevant research in child-computer interaction. The review of these databases has shown that reflective practices in which children are the main actors are increasingly gaining attention, but that there is substantial opportunity for further research. It is our hope that this overview of state of art will offer a starting point to formulate and conduct more research on children's reflective practices within collaborative interactions mediated by technology.

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References

1. Arias E., Eden H., Fischer G., Gorman A., Scharff E.: Transcending the Individual Human Mind—Creating Shared Understanding through Collaborative Design. In: Proceedings of Transactions on Computer-Human Interaction 7, 1, pp. 84--113. ACM Press (2000)
2. Bardram J.: Collaboratior, Coordination, and Computer Support: An Activity Theoretical Approach to the Design of Computer Supported Cooperative Work. Aarhus University (1998)
3. Baumer E.P.S., Khovanskaya V., Matthews M., Reynolds L., Sosik V.S., Gay G.: Reviewing Reflection: On the Use of Reflection in Interactive System Design. In: Proceedings of DIS'14, pp. 93--102. ACM Press (2014)
4. Baykal G.E., Eriksson E., Björk S., Torgersson O.: Using Gameplay Design Patterns to Support Children's Collaborative Interactions for Learning. In: Proceedings of CHI EA'19, Article LBW0168, 6 pages. ACM Press (2019)
5. Baykal G.E., Van Mechelen M., Wagner ML., Eriksson E.: What FabLearn talks about when talking about reflection-A systematic literature review. International Journal of Child-Computer Interaction, 100256 (2021)
6. Belgrave M.J., Keown D.J.: Examining Cross-Age Experiences in a Distance-Based Intergenerational Music Project: Comfort and Expectations in Collaborating with Opposite Generation Through "Virtual" Exchanges. Frontiers in Medicine 5. August (2018)
7. Bolter J., Gromala D.: Transparency and Reflectivity: Digital art and the aesthetics of interface Design. In: Fishwick, P. (ed.). Aesthetic Computing. The MIT Press, Cambridge, Massachusetts (2006)
8. Boud D., Keogh R., Walker D.: Reflection: Turning experience into learning. London, England: Kogan Page (1985)
9. Charisi V., Malinverni L., Schaper M., Rubegni E.: Creating Opportunities for Children's Critical Reflections on AI, Robotics and Other Intelligent Technologies. In: Proceedings of IDC'20 (London, United Kingdom), pp. 89--95. ACM Press (2020)
10. Ching C.C., Kafai Y.B.: Peer Pedagogy: Student Collaboration and Reflection in a Learning-Through-Design Project. Teachers College Record journal 110, 12, pp. 2601--2632 (2008)

11. David B.: Assessing capability in design and technology: the case for a minimally invasive approach. Design and Technology Education: an International Journal 12, 2 (2008)
12. Dewey J.: Democracy and Education: An Introduction to the Philosophy of Education. Macmillan (1916)
13. Dewey J.: How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process Vol. 8. Southern Illinois Up, 1986/2008. (1933)
14. Dochy F., Segers M., Sluijsmans D.: The use of self-, peer and co-assessment in higher education: A review. Studies in Higher Education 24, 3, pp. 331--350 (1999)
15. Dunning D., Heath C., Suls J.M.: Flawed self-assessment: Implications for health, education, and the workplace. Psychological Science in the Public Interest 5, 3, pp. 69--106 (2004)
16. Engeström Y.: Learning by expanding: An activity-theoretical approach to developmental research. Helsinki: Orienta-Konsultit (1987)
17. Engeström Y., Brown K., Christopher L.C., Gregory J.: Coordination, Cooperation, and Communication in the Courts: Expansive Transitions in Legal Work. In Mind, Culture, and Activity. Seminal Papers from the Laboratory of Comparative Human Cognition, M. Cole, Y. Engeström, O.A. Vasquez (Eds.), Chapter 28, 369--388. Cambridge University Press (1997)
18. Eriksson E., Iversen O.S., Baykal G.E., Van Mechelen M., Smith R., Wagner ML., Fog B.V, Klokmose C., Cumbo B., Hjorth A., Have Musaeus L., Graves Petersen M., Bouvin N.O.: Widening the Scope of FabLearn Research: Integrating Computational Thinking, Design and Making. In: Proceedings of the FabLearn Europe'19 Conference (Oulu, Finland). Article 15, 9 pages. ACM Press (2019)
19. Eshuis E.H., ter Vrugte J., Anjewierden A., Bollen L., Sikken J., de Jong T.: Improving the quality of vocational students' collaboration and knowledge acquisition through instruction and joint reflection. International Journal of Computer-Supported Collaborative Learning 14, 1, pp. 53--76. March (2019)
20. Fleck R., Fitzpatrick G.: Reflecting on Reflection: Framing a Design Landscape. In: Proceedings of OZCHI'10, pp. 216--223. ACM Press (2010)
21. Fridberg M., Thulin S., Redfors A.: Preschool children's Collaborative Science Learning Scaffolded by Tablets. Research in Science Education 48, 5, pp. 1007--1026. June (2017)
22. Gabelica C., Van den Bossche P., Segers M., Gijselaers W.: Feedback, a powerful lever in teams: A review. Educational Research Review 7, 2, pp. 123--144. (2012)
23. Gourlet P., Eveillard L., Dervieux F.: The Research Diary, Supporting Pupils' Reflective Thinking during Design Activities. In: Proceedings of IDC'16, pp. 206--217. ACM Press (2016)
24. Grant M.J., Booth A.: A typology of reviews: an analysis of 14 review types and associated methodologies. Health information & libraries journal 26, no. 2, pp. 91--108 (2009)
25. El Hamamsy L., Johal W., Asselborn T., Nasir J., Dillenbourg P.: Learning By Collaborative Teaching: An Engaging Multi-Party CoWriter Activity. In: 28th International Conference on Robot and Human Interactive Communication (RO-MAN). IEEE. (2019)
26. John Hattie and Helen Timperley. 2007. The Power of Feedback. *Review of Educational Research* 77, 1, pp. 81--112. March (2007)
27. Jamil I., O'Hara K., Perry M., Karnik A., Subramanian S.: The effects of interaction techniques on talk patterns in collaborative peer learning around interactive tables. In: Proceedings of SIGCHI '11, pp. 3043--3052. ACM Press (2011)

28. Johnston L., Miles L.: Assessing contributions to group assignments. Assessment & Evaluation in Higher Education 29, 6, pp. 751--768 (2004)
29. Kafai Y., Vasudevan V.: Hi-Lo tech games. In: Proceedings of IDC '15, pp. 130--139. ACM Press (2015)
30. Kafai Y.B., Burke Q.: The Social Turn in K-12 Programming: Moving from Computational Thinking to Computational Participation. In: Proceeding SIGCSE '13, pp. 603--608. ACM Press (2013)
31. Kant I.: Critique of the Power of Judgment. In: P. Guyer (ed.). Cambridge University Press, Cambridge (2011)
32. Levina N.: Collaborating on multiparty information systems development projects: A collective reflection-in-action view. Information systems research 16, 2, pp. 109--130 (2005)
33. Loh B., Radinsky J., Russell E., Gomez L.M., Reiser B.J., Edelson D.C.: The progress portfolio. In: Proceedings of SIGCHI '98, pp. 627--634. ACM Press (1998)
34. Moon J.: Reflection in Learning & Professional Development Theory & Practice (1999)
35. Phielix C., Prins F.J., Kirschner P.A.: Awareness of group performance in a CSCL - environment: Effects of peer feedback and reflection. Computers in Human Behavior 26, 2, pp. 151--161 (2010)
36. Phielix C., Prins F.J., Kirschner P.A., Erkens G., Jaspers J.: Group awareness of social and cognitive performance in a CSCL environment: Effects of a peer feedback and reflection tool. Computers in Human Behavior 27, 3, pp. 1087--1102 (2011)
37. Pitkänen K., Voldborg Andersen H.: Empowering Teachers and New Generations through Design Thinking and Digital Fabrication Learning Activities. In: Proceedings FabLearn Europe'18, pp. 55--63. ACM Press (2018)
38. Prinsen F., Terwel J., Volman M., Fakkert M.: Feedback and reflection to promote student participation in computer supported collaborative learning: A multiple case study. pp. 132--162, Springer, Boston, MA (2008)
39. Quinton S., Smallbone T.: Feeding forward: Using feedback to promote student reflection and learning – A teaching model. Innovations in Education and Teaching International 47, 1, pp. 125--135 (2010)
40. Renner B., Kimmerle J., Cavael D., Ziegler V., Reinmann L., Cress U.: Collaborating on multiparty information systems development projects: A collective reflection-in-action view. Journal of medical Internet research 16, 3, e85 (2014)
41. Saab N., van Joolingen W.R., van Hout-Wolters B.H.A.M.: Supporting Communication in a Collaborative Discovery Learning Environment: the Effect of Instruction. Instructional Science 35, 1, pp. 73--98. July (2006)
42. Sadler D.R.: Formative assessment and the design of instructional systems. Instructional Science 18, 2, pp. 119--144. June (1989)
43. Saksono H., Parker A.G.: Reflective Informatics Through Family Storytelling. In: Proceedings of CHI'17, pp. 5232--5244. ACM Press (2017)
44. Sas C., Dix A.: Designing for Reflection on Experience. In: Proceedings of CHI EA'09, pp. 4741--4744. ACM Press (2009)
45. Schön D.A.: Educating the reflective practitioner: toward a new design for teaching and learning in the professions. Jossey-Bass, San Francisco (1987)

46. Sedrakyan G., Malmberg J., Verbert K., Järvelä S., Kirschner P.A.: Linking learning behavior analytics and learning science concepts: Designing a learning analytics dashboard for feedback to support learning regulation. Computers in Human Behavior 107, 105512. June (2020)
47. Shimoda T., White B., Borge M., Frederiksen J.: Designing for science learning and collaborative discourse. In: Proceedings of IDC '13, pp. 247--256. ACM Press (2013)
48. Sinervo S., Sormunen K., Kangas K., Hakkarainen K., Lavonen J., Juuti K., Korhonen T., Seitamaa-Hakkarainen P.: Elementary school pupils' co-inventions: products and pupils' reflections on processes. International Journal of Technology and Design Education, 31, No:4, pp. 653--676. March (2020).
49. Slovák P., Frauenberger C., Fitzpatrick G.: Reflective Practicum: A Framework of Sensitising Concepts to Design for Transformative Reflection. In: Proceedings of CHI '17, pp. 2696--2707. ACM Press (2017)
50. Smith R.C., Iversen O.S., Hjorth M.: Design thinking for digital fabrication in education. International Journal of Child-Computer Interaction 5, pp. 20--28. September (2015)
51. Vygotsky L.S.: Mind in Society: The Development of Higher Psychological Processes. Harvard University Press (1978)
52. Wise A., Antle A.N., Warren J.W.: Explanation-giving in a collaborative tangible tabletop game: Initiation, positionality, valence and action-orientation. In: Proceedings of ICLS'17 (2017)
53. Yanow D., Tsoukas H.: What is reflection-in-action? A phenomenological account. Journal of Management Studies 46, 8, pp. 1339--1364 (2009)
54. Zhang Z., Bekker T., Markopoulos P., den Brok P.: Children's Reflection-in-Action During Collaborative Design-Based Learning. In: The Challenges of the Digital Transformation in Education. Springer International Publishing, pp. 790--800 (2019)