and Kirschner, 2018). Education scientists have for long called for a greater attention to underlying assumptions about learning (e.g., Biggs, 1996)—as have IS researchers (e.g., Alavi and Leidner, 2001). Reviewing the final sample regarding prevalent and emerging research themes leads us to identify four major themes in the current scientific discourse relevant for current and future research in this field:
(i) Regarding learning tool support, the review indicates that almost half of the reviewed publications suggest tool support for learning and teaching conceptual modeling with a focus on modeling tool support. Recently, these approaches are complemented by learning management systems and e-learning platforms supporting learners in this field. However, only few tool support approaches reflect on fundamental presuppositions, theories and learning approaches which in these few cases refer to a constructivist perspective on learning including the approaches of active and collaborative learning. This is surprising because a differentiated understanding of the intended learning processes and addressed learning difficulties provides guidance for designing modeling tool support or e-learning platforms (e.g., Alavi and Leidner, 2001). Hence, discussing the design of tool support for learners in the light of fundamental considerations on learning and their implications on learning support and assistance remains a promising research direction, e.g., through the lens of constructivist learning theories (e.g., Biggs, 1996). A first step could be to investigate learners' difficulties and barriers learners of conceptual modeling face in order to achieve a detailed understanding of learners' needs informing future design research on learning tool support.
(ii) Regarding feedback (to learners), the review finds a distinct focus on automated, process-oriented feedback—which, interestingly, can be traced back to suggestions in the 1990s (Gordon and Hall, 1998). Reviewing feedback approaches suggests that reflections on different kinds of feedback and, especially, interrelations with learning paradigms and learning approaches are scarce in the review sample. However, different perceptions of learning processes are assumed to translate into different kinds of feedback (e.g., Sedrakyan and Snoeck, 2017, p. 71) which are discussed regarding various purposes and regarding the timing of providing feedback—exhibiting considerable differences in terminology (Serral and Snoeck, 2016). Hence, exploring feedback for learning conceptual modeling in the light of learning paradigms, learning approaches and accompanying interpretations of learning processes constitutes a fruitful direction for future research. In addition, research on feedback solutions for learners of business process modeling opens a further path for future research to close the identified gap of missing contributions with this particular focus—especially given the relevance of business process modeling for IS research and practice (e.g., Davies et al., 2006; Recker et al., 2009).
(iii) With regard to learning analytics, it is observed that research in the review sample focuses on data mining techniques and other similar approaches for data collection. However, restricting data collection to logging modeling tool interactions constitutes a principle limitation of the presented approaches, and neglects other, presumably equally important aspects of the learning process, e.g., learner motivation and willingness-to-learn or the use of additional tools outside of the modeling tool, e.g., paper-based modeling. For example, asking learners to think out loud while working on a modeling task ("think aloud" verbal protocols, see Ericsson and Simon, 1980, 1993) promises further and more detailed insights into their reasoning (e.g., Haisjackl et al., 2016). Further reflection on assumptions about how learning occurs with respect to learning paradigms and learning approaches promises to provide guidance for exploring further techniques for collecting data as basis for learning analytics—constituting a fruitful avenue for future research studying learning and teaching conceptual modeling.
(iv) The gamification of learning conceptual modeling is identified as emerging research theme in the review sample—in line with increasing research interest in gamification and serious games in various disciplines (e.g., Deterding et al., 2011; Liu et al., 2013). Since virtual and augmented reality technology has even entered smartphones and tablets, it is evident to link these technologies to innovative teaching and learning strategies for conceptual modeling. Moreover, the review finds only very few contributions to this research theme so far (e.g., Al-Tahat, 2014) which opens a path for innovative, original contributions. Moreover, in the light of the recent emphasis on active and collaborative learning, the gamification of learning and teaching conceptual modeling adds a new angle which is assumed to increase learners' motivation and engagement. However, further research is needed to evaluate such (hypo-)theses and, hence, constitutes another path for future research on learning and teaching conceptual modeling.

6 Conclusion

Analyzing prior work on learning conceptual modeling leads us to identify (i) learning tool support, (ii) feedback, (iii) learning analytics and (iv) gamification/serious games as prevalent and emerging research themes in the scientific discourse in this field. Reflections on underlying learning paradigms, learning theories, teaching methods or, more generally, assumptions about learning have surfaced surprisingly rarely in the analyzed literature. Hence, the present findings encourage further discussion on framing the learning of conceptual modeling in the light of learning paradigms and let us outline four major suggestions for future research which provide the opportunity to tie in with a large body of literature in education sciences and instructional design research: (1) Design research on tool support for learning and teaching conceptual modeling informed by fundamental considerations on learning processes and their implications on learning support and assistance in line with learners' needs; (2) Exploring approaches for providing (automated) feedback to learners of conceptual modeling in the light of different perceptions of learning processes; (3) Considering further data collection approaches as basis for learning analytics for conceptual modeling beyond learner-tool interactions, e.g., verbal protocols or further contextual information; (4) Design research on applying virtual and augmented reality technology for gamifying the learning of conceptual modeling in the light of active and collaborative learning approaches, accompanied by evaluating the impact of the technology use on learning processes. Overall, the present findings strongly suggest that the current discussion will benefit substantially from further contributions taking complementary angles and methodological stances on learning conceptual modeling involving theoretical, empirical and design science research to jointly advance our knowledge on learning (and teaching) conceptual modeling. Research efforts following the suggested directions are expected to also benefit practitioners in teaching conceptual modeling by providing new instructional designs and methods building upon tool support informed by reflections on learning paradigms and learning approaches.

Acknowledgments

We would like to thank the associate editor and the four reviewers for their constructive comments and their valuable suggestions which greatly helped us to improve the manuscript.

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