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Unrooting the illusion of one-size-fits-all feedback in digital learning environments

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Chapter 6

General Discussion

General Discussion

The aim of my dissertation was to critically review digitally delivered instructional feedback and investigate which situational and intrapersonal factors influence the processing of digitally delivered feedback and subsequent effects on learning performance. To this end, I conducted two reviews and two empirical studies. In the two reviews, I started with mapping out situational factors (clustered in context, content, and task factors) and intrapersonal factors—clustered in cognitive, metacognitive, and motivational factors—related to digitally delivered instructional feedback across disciplines, educational levels, and learning tasks. By using the same set of data in both reviews, I acknowledged the complexity of the learning context as well as elucidated the roles of these two sets of clusters.

In the two empirical studies, the broad focus of situational and intrapersonal factors was narrowed down by adopting a learner-focused approach that tapped into the role of intrapersonal factors during expository text comprehension. Each empirical study used expository texts that were presented to the learners in a Digital Learning Environment (DLE). The DLE offered both mandatory and optional preprogrammed instructional feedback to support readers during reading. Mandatory feedback was provided for each response on multiple-choice questions, whereas optional preprogrammed feedback leaves room for the learner to engage in feedback-seeking behaviour (FSB) through monitoring (observing others that receive feedback from a feedback source) and/or inquiry (directly asking a feedback source). The learner's intrapersonal factors play a role in the seeking and processing of instructional feedback, and their subsequent effect on the learner's mental text representation. The possible interactions of intrapersonal factors within the learner and with situational factors are numerous and complex.

In the following sections, I will first summarize the most pressing findings from each review and empirical study, followed by an integration of these findings. Furthermore, I will reflect on the limitations from my dissertation as a whole as well as provide suggestions for future research. Last, I will discuss the implications for research and practice.

Summary of Main Findings

In *Chapter 2*, a meta-analysis was conducted to investigate the effects of context, content, and task factors of digitally delivered feedback on learning performance of adolescents and (young) adults. More specifically, for each cluster (i.e., context, content, and task factors), I examined which factors were most effective in improving learning performance. The cluster of *context factors* included educational level, feedback timing, learner control, rewards, and study setting. The cluster of *content factors* comprised the categories of feedback form, feedback focus, and feedback function, whereas the cluster of *task factors*, consisted of the categories assessment developers, assignment, discipline, and feedback display. The results from the moderator analysis showed a moderate, observed summary effect on learning performance of Hedges' $g = .41$ for 116 interventions extracted from 46 articles. A publication bias was present in my sample; adjusting for this bias led to a lower summary effect of Hedges' $g = .23$. A comparison of interventions that included a control condition with or without some feedback (regardless of what this feedback encompasses) showed that some feedback is more effective than no feedback.

Next, a series of moderator analyses was employed for each factor from the three aforementioned clusters to test its effect on learning performance. As for context factors, the variation in effects between the subcategories was statistically detectable for educational level (high school), feedback timing (delayed feedback), learner control (decision made by others), and study setting (lab-setting). The subcategory with the highest significant effect size is mentioned between parentheses. Also for the remainder of this paragraph, I will display the subcategory with the highest significant effect size between parentheses (if applicable). Learning performance was unaffected by whether participants received a reward for participation. Most research was conducted in higher education compared to primary and secondary education. As for content factors, the variation in effects between the subcategories was statistically detectable for feedback form (simple feedback), feedback focus (process), and feedback function (metacognitive). Feedback focus on the process was divided into surface and deep strategies with Hedges $g = .53$ and $.09$, respectively, but displayed a non-significant detectable variation. Statistically detectable means that the feedback interventions do not share the same true effect size, in which the differences between subcategories within each factor is not the result of random error (or chance) alone. As for task factors, the variation in effects between the subcategories was statistically detectable for assessment developers (standardized tests), assignment (oral), discipline (science education), and feedback display (visualization).

Last, a forward metaregression was employed to examine the conjoint influence of significant moderators on learning performance. This metaregression, in which the inclusion of a control group was set as a baseline model, was performed on a selection of significant moderators. This selection of moderators was based on factors that could be adapted by teachers to complement a DLE and included learner control, feedback timing, feedback form, feedback focus, feedback function, and feedback display. Only feedback focus improved the basic model ($\chi^2 = 24, df = 6, p = .00$), whereas the remaining factors did not improve the model fit. Despite that many factors positively contributed to learning performance—as displayed in the series of moderator analyses per cluster—my attempt to examine the conjoint influence of factors showed that the feedback focus was the only factor that could possibly be generalized across educational contexts.

In *Chapter 3*, I reported on a systematic review that was performed to examine the operationalization of intrapersonal factors in digitally delivered feedback research with adolescents and (young) adults. The same sample of articles from *Chapter 2* was used for this study; however, more articles were included in this review than in the meta-analysis as there was no need to adhere to specific statistical requirements for the systematic review. This chapter specifically focused on the learner's intrapersonal factors, because digitally delivered feedback research displays a dominant focus on investigating feedback effects on learning performance and neglects or narrowly considers the role of the individual learners with their (clusters of) intrapersonal factors. I opted for a systematic review rather than a meta-analysis due to the descriptive nature of the topic, while allowing for sufficient detail and power for necessary statistical analyses. In the systematic review, I included 71 articles that reported on 99 studies across 198 cases. Articles were coded along two dimensions, distinguishing between articles mentioning the essential role of intrapersonal factors for feedback(-processing) in

the theoretical framework (Dimension A) and articles that did not explicitly mention this essential role (Dimension B). Per dimension, I examined how measures were operationalized per case-level according to five themes: (a) cluster of intrapersonal factors in terms of cognition, metacognition, and motivation, (b) type of measurement (e.g., self-reports, performance scores), (c) multiple measures of the same factor, (d) goal for measuring the factor (e.g., pretest, posttest), and (e) measurement focus (i.e., primary, secondary).

Most studies were conducted in higher education compared to primary and secondary education. None of the studies mentioned a feedback training for the participants. In total, sixty-two (62.2%) out of 99 studies acknowledged the essential role of intrapersonal factors. No differences existed between studies from Dimension A and B in terms of the five themes, meaning that my initial assumption about emphasizing the essentialness does not lead to a different operationalization. In general, research is overrepresented by cognitive measures (Dimension A: 57.6% of the cases; Dimension B: 48.5% of the cases), whereas metacognitive and motivational measures occurred less often (Dimension A: 11.4% and 12.9% of the cases, respectively; Dimension B: 13.6% and 22.7% of the cases, respectively). In both dimensions, none of the studies included all three main clusters of intrapersonal factors. Cases reporting on two out of three clusters of intrapersonal factors occurred in 11 out of 47 articles from Dimension A and 8 out of 24 articles from Dimension B.

Finally, indicators for data that could be used to determine the influence of the (clusters of) intrapersonal factors on the processing of feedback and/or learning performance consisted of a pretest-posttest design (measurement goal) and a primary focus in the study (measurement focus). Twenty-nine (22.0%) of the cases in Dimension A and nineteen (28.8%) of the cases in Dimension B met these two requirements.

Chapter 4 reported on an empirical study with 123 secondary school learners that examined the influence of metacognition, motivation, and feedback-seeking on expository text comprehension. Path analysis was carried out (a) to examine the direct and indirect effects of Feedback-Seeking Behaviour (FSB), metacognition, and motivation (self-report questionnaire) on expository geography text comprehension (i.e., multiple-choice questions, the quality of writing a summary, and a composite indicator); and (b) to determine whether these direct and indirect effects differ for three text comprehension indicators (multiple-choice questions as indicator, summary quality as indicator, and a composite indicator). I found no evidence for a direct relation between FSB, metacognition, motivation, and any of the three expository text comprehension indicators. Despite the lack of direct effects, I found it essential to still examine the indirect effects, because I wanted to get a clearer picture of the influence of FSB, metacognition, and motivation in relation to one another and to the three indicators for expository text comprehension. However, interpreting indirect effects without confirming the existence of direct effects warrants caution. I hypothesized that FSB monitoring and inquiry could mediate the relations between metacognition and motivation, and the three expository text comprehension indicators. These mediation models were saturated and fitted poorly, which I attribute to the relatively small sample.

Chapter 5 adopted a learner-oriented approach to allow for derivation of profiles based on Feedback-Seeking Behaviour (FSB), metacognitive reading strategies (global reading, support reading, and problem solving strategies), and motivational facets (task value, test anxiety, self-efficacy, control of learning beliefs), and to subsequently evaluate if these profiles can predict expository text comprehension. Similar to *Chapter 4*, I made a distinction in comprehension indicators and included multiple-choice questions and the summary quality as separate expository text comprehension indicators. In addition, these two indicators can be combined into a composite indicator, in which the two indicators are equally weighted. Latent Profile Analysis (LPA) was performed three times—once with both comprehension indicators as dependent variables, once with multiple-choice questions as dependent variable, and once with the summary quality as dependent variable—with exploration of 1 up to 6 solutions each. For each of the three text comprehension indicators, a three-profile solution best fitted the data from 130 secondary-school learners. Henceforth, I will only report on results based on the composite indicator because combining closed-questions (multiple-choice) and open-ended questions (summary writing) resembles the most realistic learning situation (i.e., typical for teaching practice).

Learners whose self-reported scores on FSB, metacognitive reading strategies, and motivational facets best fitted the first profile—that of the *underdeveloped* strategists ($n = 47, 36.0\%$)—were characterized by the lowest scores on all metacognitive reading strategies, motivational facets, and the highest score for test anxiety compared to corresponding scores in other profiles. Learners whose self-reported scores best fitted the second profile—that of the *intermediate* strategists ($n = 64, 49.0\%$)—displayed moderate scores on all metacognitive reading strategies, motivational facets, and FSB. The score for text anxiety had the lowest value compared to corresponding scores in other profiles. Learners whose scores best fitted the third profile—that of the *advanced* strategists ($n = 19, 15.0\%$)—were best described by the highest scores for all metacognitive reading strategies and motivational facets, and a moderate score for test anxiety compared to corresponding scores in other profiles. The differences in scores between the three profiles were significant for all metacognitive reading strategies and motivational facets with the exception of test anxiety. The scores on the text comprehension indicators did not differ between the profiles. Furthermore, for both indicators small effects were found ($\eta_p^2 = .04$ for multiple-choice questions; $\eta_p^2 = .05$ for the summary).

Integrative Findings

In this section, I will integrate findings from the different *chapters* and discuss what the findings from my dissertation as a whole may imply. The aim of my dissertation was to critically review the effects of digitally delivered instructional feedback on learning performance by investigating situational and intrapersonal factors. The two reviews and two empirical studies included in this dissertation focused on distinct aspects of the feedback process, as an attempt to grasp its complexity and to understand its subsequent effects on learning (Hattie & Timperley, 2007; Kluger & DeNisi, 1996) and in particular on expository text comprehension (*Chapters 4* and *5*). This complexity is—at least partly—acknowledged as I combined multiple factors stemming from context, content, task, and/or intrapersonal factors, implemented multiple measurements of learning performance, and assigned learners a central

role. As I attempted to avoid contributing to (and upholding of) a scattered repository of feedback research, I adopted an integrative perspective by reviewing existing research on digitally delivered feedback in terms of context, content, and task factors (*Chapter 2*) and of (clusters of) intrapersonal factors (*Chapter 3*). The central role of the learner became apparent in *Chapters 4* and *5*. Both chapters focused on a combination of the learner's intrapersonal factors—by using two different analyses (path analysis and LPA)—in building a coherent mental text representation, albeit with varying results in terms of usefulness of findings. In the sections below, I will discuss and integrate the most pressing findings in accordance with the rationale as to why my dissertation was conducted and how my findings contribute to the field. These motives comprise a unidimensional view on digitally delivered instructional feedback, including the illusion of one-size-fits-all feedback content, the conjoint role of intrapersonal factors (with the learner having a central role), and the stepwise nature of the feedback process by separating seeking, receiving, processing, and implementing mandatory evaluative or informative optional feedback.

A Unidimensional View on Instructional Feedback

Evidence for a unidimensional view on instructional feedback can be found in my meta-analysis and systematic review. This view is predominantly evidenced by feedback research and practices in higher education (rather than in primary and secondary education; *Chapter 2*), a posttest-only or pretest/posttest design (*Chapter 2*), and with the inclusion of predominantly cognitive measures (*Chapter 3*). The dominant focus on feedback research in higher education becomes apparent by the number of interventions from higher education included in the meta-analysis, exceeding the number of feedback interventions conducted in lower educational levels. This finding is in line with the number of interventions reported by Van der Kleij et al. (2015): the majority of the interventions was conducted in higher education, followed by interventions from secondary and primary education (in this order). In combination with the difference in effects of educational level on learning performance, it is unclear whether instructional feedback in higher education can be seamlessly matched to feedback in primary and secondary education. Furthermore, from a theoretical perspective, this match seems unlikely because educational levels comprise different situational factors (such as time tables, learning continuity pathways) and (clusters of) intrapersonal factors (e.g., maturation of cognitive processes). As a result, the interactions with and between situational factors and clusters of intrapersonal factors might be different in primary and secondary education. In a similar vein, the dominant cognitive feedback function in higher education—as illustrated by a majority of interventions using cognitive measures—cannot be seamlessly replaced with research focused on metacognition and/or motivation from primary and/or secondary education. These foci are complementary and contribute in varying degrees to learning, as supported by effect sizes varying from small to large effects for the various combinations of clusters of intrapersonal factors (cognitive and metacognitive, cognitive and motivational, or a combination of all three clusters). *Chapter 5* also provides support for the complementary role of the clusters of intrapersonal factors metacognition, motivation, and FSB. Although *Chapter 4* has potential to support this complementary role as well, including these results as support seems invalid due to the saturated and poor fitting models.

The illusion(s) of one-size-fits-all feedback content. To efficiently deliver feedback to learners, practitioners tend to deliver the same feedback or instruction to all learners. For good reason, this approach has several advantages, such as saving time and effort (Munshi & Deneen, 2018). In particular with DLEs, preprogrammed instructional feedback is delivered to learners mandatory or optional upon request by the learner. Irrespective of the feedback being mandatory or optional, the external feedback message is frequently the same for all learners. Despite the positive effects of this preprogrammed instructional feedback on learning (cf. Hattie & Timperley, 2007; Jaehnig & Miller, 2007; Kluger & DeNisi, 1996; Swart, Nielen, & Sikkema-de Jong, 2019; Van der Kleij et al., 2015), critically reviewing this type of feedback shows that the studies are based on three implicit assumptions: (a) learners are preferably able to benefit from the same external programmed feedback message, (b) all learners will process the content of the instructional feedback message in the same way, and (c) all learners—who receive and process this message—are expected to show similar effects on learning performances. In other words, one-size-fits-all instructional feedback content is assumed suitable to improve learning performances by all students. My dissertation shows that conducting research with this one-size-fits-all instructional feedback content is illusional. I will discuss per chapter (i.e., per study) how its design was rationalized to counter the three implicit assumptions, followed by how the findings provided evidence against a one-size-fits-all instructional feedback content. Last, I will shortly address the feedback process as a series of steps and explain why one-size-fits-all feedback content does not fit that view.

Inclusion of multiple clusters/factors. My decision to include multiple clusters of situational factors—stemming from context, content, and task factors—in my meta-analysis (*Chapter 2*) accounted for the possible interactions of learners with situational factors. The interactions occur within the learner—despite the exclusion of the learner's intrapersonal factors in *Chapter 2*—and/or between the learner and situational factors. The exclusion of intrapersonal factors in *Chapter 2* did not rule out the influence of these factors on the processing of feedback and/or on learning performance. By focusing on situational factors, whilst acknowledging and explicitly stating that the learner's intrapersonal factors also play an essential role, the meta-analysis is not distorted by the implicit assumptions contributing to a one-size-fits-all approach. Employing a metaregression—besides the series of moderator analyses—was an attempt to combine situational factors to find a collection of situational factors with a positive influence on learning performance. The goal of my meta-analysis was to find a collection of factors that is generalizable across a broad range of educational contexts. Due to the high number of significant moderators, the power of the metaregression would remain low and provided models that were too full. The number of factors in the model was minimized by implementing a forward regression focused on factors that could be adapted by practitioners: learner control, feedback timing, feedback form, feedback focus, feedback function, and feedback display. These moderators were added in a stepwise manner to a basic model with interventions that included a control group. Only the model with a control group included and the predictor feedback focus showed the best improvement in model fit ($\chi^2 = 24$, $df = 6$, $p \leq .001$). The lack of significant moderators in my metaregression illustrates that amongst a collection of situational factors, no combination of factors could be derived that positively contributes to learning performance. Thus, the results of my meta-analysis

show that there is no one-size-fits-all feedback content suitable across a range of context for all learners, and, therefore, counter the implicit assumptions that learners are able to—preferably—benefit from the same external programmed feedback message.

I also explored multiple clusters of intrapersonal factors—stemming from cognition, metacognition, and motivation—in my systematic review (*Chapter 3*), again building upon the fact that numerable interactions between the learner and situational factors are in play when processing instructional feedback. In my systematic review, I distinguished between articles acknowledging the essential role of intrapersonal factors in the processing of feedback and/or on learning performance and those who did not acknowledge this role. This stresses the central role of learners as they might process instructional feedback differently as a result of the interactions between the learner and situational factors. This unique contribution from individual learners counters the assumption that views all learners as processing the same feedback message in the same way.

Chapters 4 and *5* also underscore the need to include multiple clusters of intrapersonal factors, namely metacognition and motivation complemented by feedback-seeking. Initially, the cluster of intrapersonal factors ‘cognition’ was part of *Chapter 4*; however, this scale had to be deleted due to a low internal reliability in the pilot study. Despite the inclusion of the same components in *Chapters 4* and *5*, the data were gathered separately and were analysed with different techniques (path analysis and LPA, respectively) to acknowledge the complex combination of factors. I discuss these chapters simultaneously because they involved the same components, namely feedback-seeking (behaviour), the clusters of intrapersonal factors metacognition and motivation, and expository geography text comprehension. However, due to saturated and poor fitting models the results from *Chapter 4* must be approached more carefully than the results from *Chapter 5*. Essential differences exist between the two studies from *Chapters 4* and *5*. One difference is how feedback-seeking was measured. I would refer to these as feedback-seeking behaviour, operationalized by self-report items (*Chapter 4*) and number of informative optional feedback requests as gathered in the DLE log files (*Chapter 5*), because what learners think they do (i.e., self-reported) might differ from what they actually do (i.e., actual clicks as an behaviour). In addition, the items for the clusters metacognition and motivation differed in their contents. The items in *Chapter 4* had a broad focus, meaning that the items were applicable to learning in general, whereas the items in *Chapter 5* were tailored to fit the school subject geography. With regard to metacognition, *Chapter 4* focused primarily on metacognitive monitoring—i.e., the selected scale with a good estimated reliability—and *Chapter 5* more on metacognitive reading strategies. With regard to motivation, *Chapter 4* focused more on aspects of motivation that were directed towards the willingness to receive feedback (labelled as feedback propensity) and behaviours directed towards protecting an image that other people may have about the learner (labelled as self-enhancement). In *Chapter 5* motivational items stemming from task value, test anxiety, self-efficacy, and control of learning were tailored to match the school subject geography.

The findings from *Chapter 4* indicate that the relationship between intrapersonal factors, general feedback-seeking, and expository geography text comprehension is *highly likely* nonlinear. I placed

emphasis on the words ‘highly likely’ to indicate that I cannot further elaborate on my findings due to the relatively small sample size present in the study, which placed serious restrictions on running more complex models (i.e., models with more pathways between factors). Furthermore, the composition of the models—with significant pathways—did not differ between the three indicators for expository text comprehension. In addition, the models were poor fitting. This means that the composition and the positioning of the concepts of interest had to be arranged. Arranging the concepts into a relevant model required stepping away from the faulty assumption that learners are able to *preferably* benefit from the same external programmed feedback message. Furthermore, this re-arrangement of concepts also required reconsidering the—again faulty—assumption that all learners will process the content of the instructional feedback message *in the same way*. Last, it counters the assumptions that all learners, who receive and process this message, are expected to show similar effects on learning performances. The lack of significant pathways for multiple-choice questions, quality of writing a summary, and the composite text comprehension indicator might signal that the question format does not affect the learner’s mental text representation; however, more evidence is required for this hypothesis. The findings in *Chapter 5* reflected that higher scores on metacognitive reading strategies did not necessarily lead to higher scores on both expository text comprehension indicators. This means that learners who display higher awareness of metacognitive reading strategies do not necessarily perform better on text comprehension indicators, which counters the assumption that learners are able to preferably benefit from the *same* external programmed feedback message, that all learners will process the content of the instructional feedback message in the same way, and that all learners—who receive and process this message—are expected to show similar effects on learning performances. In a similar vein, I found in *Chapter 4* that higher scores on motivational facets and feedback-seeking behaviour did not necessarily lead to higher scores on either expository text comprehension indicators. The lack of linear relationships in feedback research, in particular the relationship between learners’ comprehension and feedback-processing and -seeking, and the likelihood of nonlinear relationships has already been acknowledged by Timmers, Braber-Van den Broek, and Van der Berg (2013).

Oversimplified feedback models. A second argument why a one-size-fits-all feedback is illusional, is that it portrays an oversimplified view of instructional feedback in the learning situation (e.g., Cutumisu, 2019; Fyfe & Rittle-Johnson, 2015). Studying one cluster of factors at a time (i.e., merely focusing on either context, content, or task factors, or intrapersonal factors) does not acknowledge the complexity that instructional feedback brings to learning. Indeed, simplified modelling can be helpful to gain insight in, for example, a small selection of processes, but it resembles an incorrect and incomplete view of instructional feedback. Observations in practices seem to suggest that simplified modeling can be meaningless, as there are limited or only a few similarities between research and practice in terms of feedback sources, involved actors, learning goals, and so on. For example, I imagine a learner has to write an essay about the consequences of volcano eruptions on different scales and from different perspectives. The requirements are 1500 words, formal writing style, amongst others. However, the learner is not interested in the topic and decides to work on it a day before the assignment has to be submitted. Eventually, the learner pulls it off and receives a B (seven out of ten in the Dutch

grading system) for his/her assignment. Viewing this learner in terms of his/her cognitive performance might portray the learner as average or sufficient, without considering motivation (not interested) or metacognition (lack of planning). A similar, simplified modelling became visible in studies including only one main cluster of intrapersonal factors (corresponding to 73.2% of all included articles), and typically only the cognitive cluster. A more complete understanding of how instructional feedback is sought, perceived, processed, implemented, and acted upon to adapt learning performance can only be gained by acknowledging the complexity that different situational and (clusters of) intrapersonal factors bring to the learning situation. In addition, research should include essential aspects of that complexity. One of these essential aspects means including multiple clusters of factors in studies and tapping into the conjoint influence of (clusters of) factors. *Chapters 4 and 5* illustrate my reasoning to combine and include multiple clusters of intrapersonal factors, albeit with different results in terms of usefulness and validity. However, as my findings also illustrate, simply including multiple factors is not enough. Without sufficient methodological and statistical quality as well as relevance for the study goal, the findings cannot be fully explained in the right context. In addition, my systematic review has shown that none of the articles included all three main clusters of intrapersonal factors (cognition, metacognition, and motivation) and that only 19 out of 71 articles included two clusters of intrapersonal factors. The remaining 52 articles included only one clusters of intrapersonal factors. The arguments why only one or two clusters are included might range from arguments closely related to the study goal as a matter of relevance to lack of statistical quality—similar to my findings from *Chapter 4*. Ideally, my systematic review would have listed a higher percentage of studies involving more than a single, or even more than two, clusters of intrapersonal factors in one research design to avoid overly simplified modelling of the feedback situation; however, the context in which these decisions are made—whether to include factors from other clusters of intrapersonal factors—is crucial. Future research can tap into these argument to provide a more complete overview as to why research focuses mainly on one cluster—or maximum two clusters—of intrapersonal factors.

A stepwise feedback process. The feedback process can be broken down in several steps. It starts with the learner detecting the error, and—after seeking or receiving mandatory or optional preprogrammed instructional feedback—noticing, decoding, and making sense of the feedback to correct the error (Timms, DeVelle, Schwanter, & Lay, 2015). This process shows that instructional feedback does not necessarily lead to processing the feedback nor to (correctly) implementing the feedback. Furthermore, it also does not necessarily lead to adaptations to learning performance. In a similar vein, despite the favourable nature of engaging in feedback-seeking—in which the learner invests resources to obtain instructional feedback to bridge the gap between the current and desired level of comprehension—there is little certainty that the act of seeking feedback leads to the processing of feedback nor adapts the learning performance. The findings in my dissertation illustrate these “uncertainties” and their complexity. The systematic review (*Chapter 3*) has shown that all researchers—from whom the studies were included in my review—implicitly assume that participants in their studies are able to (successfully) process and implement instructional feedback regardless of age (or educational level), discipline, and research goal. None of the 99 studies (derived from 71 articles) mentioned a feedback training, whilst learners probably benefit from such a training (Bevan, Badge, Cann, Wilmott, &

Scott, 2008; Weaver, 2006). Similarly, previous research has studied feedback-seeking, the clusters of intrapersonal factors metacognition and motivation, and expository text comprehension, separately and has shown that each factor contributed to expository text comprehension (Alexander, 2005; Pearson, Roehler, Dole, & Duffy, 1992). In contrast, *Chapter 4* and *5* examined the combination influence of these factors and their contribution to expository text comprehension. Both *chapters* show a weak link with expository text comprehension, as a rough indication that a mental text representation might be better explained by specifically looking at the process rather than at the end result (i.e., the learners' text comprehension). This means that learners differ in how they build their mental text representation despite a seemingly similar end result (i.e., grade). Research can tap into that process to provide practical recommendations for teachers that use expository texts in their teaching.

My findings illustrate that seeking optional feedback or receiving mandatory preprogrammed instructional feedback is not equal to processing that feedback nor does it necessarily lead to adaptations of learning performance. Although my samples in *Chapter 4* and *5* were relatively small, they provide indications of a lack of direct relationships between feedback-seeking, the intrapersonal factors, and expository text comprehension, and the lack of indirect effects, with feedback-seeking monitoring and inquiry as mediators between the intrapersonal factors and expository text comprehension (*Chapter 4*). Furthermore, the distinction between the different steps in the feedback process may also be carefully exemplified by my findings from *Chapter 5*: the fact that engaging in feedback-seeking behaviour does not necessarily lead to higher average scores on expository text comprehension indicators. If this claim was (partly) true, I would have found FSB monitoring and inquiry to be significant positive predictors in the direct effects models. The lack of significant positive correlations between FSB—divided into monitoring and inquiry in *Chapter 4* and directed towards inquiry in *Chapter 5*—and expository text comprehension indicators is already a careful indication that feedback-seeking behaviour is not equal to feedback-processing nor to adapting the mental text representation. Moreover, the positioning of concepts—for example FSB as moderator rather than mediator or prior knowledge as control variable or moderator—requires a re-evaluation. The nonsignificant differences between the three profiles with respect to feedback-seeking behaviour in *Chapter 5* is a second indicator that feedback-seeking is not equal to feedback-processing or adapting the mental text representation, because if this were the case, the differences in FSB would be significant—as indicated by the Wald statistic—and show a greater effect—as indicated by partial eta squared. I did find a common occurrence of higher scores on all metacognitive reading strategies with higher scores on motivational facets (i.e., task value, self-efficacy, and control of learning beliefs), which might indicate a co-occurrence of (clusters of) intrapersonal factors. Indeed, previous research has shown that metacognition and motivation are correlated, albeit that metacognition and motivation were measured with different instruments than in my dissertation (see Arslan & Akin, 2014; Landine & Stewart, 1998; Law, 2010). Test anxiety did not fit this pattern nor did feedback-seeking. All in all, my findings might suggest that metacognitive reading strategies and motivational facets can be successful indicators of differences in the processing of preprogrammed instructional feedback.

The Role of Intrapersonal Factors

The individual learner subsumes a relatively large role in the feedback process (Narciss, 2013; Strijbos & Müller, 2014), especially when feedback is (partly) digitally delivered the learners' intrapersonal factors become more apparent (Narciss, 2008; Shute, 2008) as a result of the involvement of different psychological and logistical processes (Winstone, Nash, Rowntree, & Parker, 2017; Wu, Xu, Kang, Zhao, & Liang, 2019). In the following sections, I will elaborate on my findings that exemplify and clarify the role of intrapersonal factors in seeking and processing of preprogrammed instructional feedback. In addition, I will set forth why combining (clusters of) intrapersonal factors is essential for conceptualizing instructional feedback.

Integration rather than isolation. The systematic review in *Chapter 3* and findings from *Chapter 4* and *5* illustrates the need for an integrative approach to the study of the influence of (clusters of) intrapersonal factors, feedback-seeking behaviour, and learning performances (e.g., expository text comprehension). An integrative approach to studying the effects of instructional feedback on building a mental text representation would resemble reading situations in practice due to the broad range of challenges that learners experience while reading expository texts (see Berkeley et al., 2016; Gregg & Sekeres, 2006; Roehling, Hebert, Nelson, & Bohaty, 2017). In addition, such an approach would also match the availability of feedback sources in a classroom, that is, learners might share feedback with peers, or the teacher may provide additional instruction based on the expository text comprehension results in the DLE.

Integrating findings from *Chapters 2* and *5* provide additional support as to why it is necessary to step away from the illusion of one-size-fits-all feedback content. I warrant caution due to the difference in specificity of the learning situation: *Chapter 2* focuses on a broad range of learning tasks whereas *Chapter 5* concerns reading expository texts for geography. Nevertheless, I find it crucial to link the findings from these chapters because these findings might provide fruitful theoretical and practical recommendations as well as input for future research. On the one hand, the metaregression in *Chapter 2* has shown that most context, content, and task factors cannot be generalized across educational contexts, which makes me to believe that the role of the individual learner rather than that of situational factors becomes of particular interest. On the other hand, findings reported in *Chapter 5* have shown that the three profiles can be better distinguished by scores on all metacognitive reading strategies and motivational facets (with the exception of text anxiety) rather than by expository text comprehension indicators. Integrating these two main findings, albeit with caution, appears to illustrate that the strategies learners have awareness/knowledge of and/or use are more useful in distinguishing learners than their learning performance (such as expository text comprehension). This might imply that if learners are to receive the same feedback message (reflecting the one-size-fits-all feedback assumption), possible differences between learners—in seeking and processing of preprogrammed instructional feedback as well as in building or adapting mental text representations—will less likely become visible when learning performances are considered.

Not passive but (pro)active learners. Learners determine whether or not to use the mandatory feedback they are given, or they determine how to use the amount of control that is given by the DLE. One way to give learners more agency or control (amongst other ways) is to provide learners options for requesting instructional feedback (Scheiter & Gerjets, 2007). Learners ideally have positive beliefs about their agency, the need or willingness to invest in learning, and whether they view their own learning as malleable (Butler & Winne, 1995). These beliefs could make the learner aware of his/her responsibility for his/her own learning and viewing themselves as having a (pro)active role in the learning process (Boud & Molloy, 2013). The findings of my meta-analysis (*Chapter 2*) show that automatically delivered preprogrammed feedback was effective in improving learning performance. Furthermore, self-paced feedback and feedback sent to the learner as a result of a decision made by others also appeared effective in improving learning performance. Only a combination of different levels of learner control (e.g., automatic and self-paced) was ineffective in improving learning performance.

Findings in my systematic review (*Chapter 3*) illustrated that only in 4% of the articles participants could decide for themselves if they wanted or needed instructional feedback. In my opinion, this percentage is quite low given the essential role that the individual learner plays in the feedback and learning process. In *Chapter 5*, I used a combination of learner control in the form of mandatory evaluative feedback (Knowledge of Result [KR] and Knowledge of Correct Result [KCR]) for multiple-choice items, and optional informative feedback targeting cognitive, metacognitive, and motivational strategies for multiple-choice questions and while writing a summary. My meta-analysis advised against combining learner control options; however, by giving learners the possibility of seeking feedback, besides mandatory KR and KCR, learners were given options of exercising control over their feedback process.

Previous research has shown that learners are not always skillful in processing the instructional feedback (see Bevan, Badge, Cann, Wilmott, & Scott, 2008; Weaver, 2006), whilst researchers assume learners can process the preprogrammed instructional feedback without difficulties (see *Chapter 3*). Thus, a feedback training has potential to help learners process and act upon the feedback. This feedback training should familiarize learners with what feedback is, how it can be managed, what needs to be done to act upon the feedback, and which roles learners play in the process as well as the roles assigned to teachers. The learner should receive multiple opportunities to practice seeking, processing, and acting upon instructional feedback (Carless & Boud, 2018). A feedback training should include a focus on the process rather than merely on the product (i.e., mental text representation; *Chapters 2 and 5*), because intrapersonal factors seem to be able to better explain variations in performance. Such a process-oriented focus should include surface- and deep-processing strategies (*Chapter 2*; e.g., metacognitive reading strategies and motivational facets) to build a coherent mental text representation (*Chapter 5*). The much-needed visibility of the different steps in processing the instructional feedback can be facilitated with DLEs (Carless & Boud, 2018). Moreover, given the increased use of DLEs, learners' reading process and text comprehension—including adaptations of their mental text representation—can be easily monitored by the learners or their teachers, because the DLE can store and display requested or delivered instructional feedback over time (Carless & Boud, 2018; Deeley, 2017; Munshi & Deneen, 2018).

Limitations and Methodological Considerations

Each chapter listed specific limitations related to that respective study; however, there are also general limitations that pertain to the dissertation as a whole. First, the samples included in my empirical studies were relatively small despite the fact that existing research has shown mixed results about acceptable samples sizes (see Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999; Kline, 2010; Reinartz, Haenlein, & Henseler, 2009). Even though the context of the studies in *Chapters 4* and *5* was constrained to a specific subject (i.e., geography) and these studies included relatively small sample sizes, my findings provide valuable insights into the essential role of (clusters of) intrapersonal factors during expository text comprehension.

Second, the development and selection of (sub)scales of instruments in *Chapters 4* and *5* appeared challenging for several reasons. First, the broad range of available instruments to measure metacognition and motivation was in most cases unsuitable for Dutch secondary school learners because the instruments were designed for English-speaking participants. Items were translated to Dutch, simplified to match the age of the target group, and made geography-specific in the context of the project *Gazelle*. This accounts for (sub)scales from the MARSJ, and the MSLQ (*Chapter 5*). In addition, some of these changes—in particular the translation and simplification of the language used in the items—were also implemented for the questionnaire used to measure metacognition, motivation, and feedback-seeking behaviour in terms of monitoring and inquiry (*Chapter 4*). I am aware that, despite rechecking the translations and simplifications of each item, this might have influenced my findings. The general nature of the self-report questionnaire—embedded in the specific context of expository text comprehension for geography—might have influenced the findings as well. Furthermore, as a result of my meta-analysis, I wanted to include two or more measures of the same construct to add quality and certainty to the results; however, the implementation of multiple measures proved to be difficult due to insufficient estimated reliability of scales. I was only partly able to include multiple measures of the same construct in *Chapter 4* and *5*. As a result, the complexity of the feedback situation was only partially captured.

Third, in my dissertation, I used interchangeably the terms feedback-seeking and help-seeking (see *Chapter 3*); however, this has implications for the findings of my dissertation as a whole. Help-seeking is a term stemming from educational research and can be defined as “an achievement behaviour involving the search for and employment of a strategy to obtain success” (Ames & Lau, 1982, p. 414), whereas feedback-seeking—stemming from workplace learning—can be defined as “the conscious devotion of effort towards determining the correctness and adequacy of one’s behaviours for attaining valued goals” (Ashford, 1986, p. 466). These definitions contain the investment of resources (e.g., effort, time), goal-setting, and an evaluation of one’s desired level of comprehension. The main difference is that the evaluation of one’s current level is explicitly stated in the definition of feedback-seeking behaviour, whereas this is not the case for help-seeking. This difference illustrates the specificity of the definitions and is deemed essential when one is looking into the different steps in the feedback- or help-seeking process. Other essential differences include clarity in the phrasing of the definitions. For the concept of help-seeking the learner’s “success” remains unspecified, whereas for feedback-seeking this “success” is reflected by a current level of comprehension (i.e., the

correctness and adequacy of one's behaviour") and possibly the desired level of comprehension (i.e., valued goals). Furthermore, the categorization of help-seeking behaviours is based on sources (e.g., formal and informal help-seeking; Karabenick, 2003), whereas categorizations of feedback-seeking behaviours are based on how and where the learner seeks feedback (Ashford, 1986; Hwang & Arbaugh, 2006). The question remains whether previous research on the topic of feedback-seeking can be seamlessly matched with help-seeking in the educational context, as I am assuming in my dissertation. However, the decision to adopt the concept of feedback-seeking rather than help-seeking was based on the amount of detail in Narciss' model (2013): the internal and external feedback loops, the gap between the current and desired level of comprehension, the series of comparisons as a result of internal and external assessment, and the selection of relevant control actions. This model provided sufficient detail that matched my conceptualization of instructional feedback—including its complexity.

Fourth, the *chapters* in my dissertation describe a series of non-significant findings in *Chapters 2, 4, and 5*. In particular, based on the many significant moderators (*Chapter 2*), I expected to have a collection of at least two or three moderators in the metaregression that would show potential generalizability. However, I only found that 'feedback focus' had the potential of being generalized across educational contexts. *Chapter 4* reported saturated and poor fitting models. Besides hindsight reflections of what I could have adopted or conceptualized differently, it is necessary to include these non-significant findings (cf. Wasserstein, Schirm, & Lazar, 2019). Research frequently focuses on what works rather than what does not. However, what does not work is also informative in explaining findings. Especially with a complex topic such as the influence of (clusters of) intrapersonal factors on the processing instructional feedback and on subsequent learning performances. Last, in *Chapter 5* feedback-seeking behaviour and the separate text comprehension indicators were the most suitable factors to discriminate between the profiles; however, the small effect sizes indicate that the factor only could minimally explain the variance in scores. Whereas the metacognitive reading strategies and motivational facets did not significantly discriminate between the profiles (as shown by significant Wald statistics), their explained variance is moderate to high (as shown by partial eta squared values).

Recommendations for Future Research

The meta-analysis and systematic review have shown that more feedback research is necessary in primary and secondary education, because these educational levels set the stage for learning to read (primary education) and reading to learn (secondary education), were unrepresented in the articles that could be included in the review studies. Especially learners in secondary education face challenging tasks involving the reading of expository texts, such as the school subject of geography (Aydin, 2011). By conducting more research in secondary education, it is possible to gain insight how learners (try to) tackle those challenges which can lead to better practical recommendations for educators.

Previous research has already shown that certain clusters of intrapersonal factors can overrule the influence of another cluster of intrapersonal factors (see Anmarkrud & Bråten, 2009). For example, a highly motivated learner can outperform learners with more prior knowledge or learners who are

better able to monitor their comprehension or progress (Anmarkrud & Bråten, 2009). More research is necessary to clarify this overruling, especially in the context on the conjoint influence of (clusters of) intrapersonal factors on seeking and processing of instructional feedback and subsequent effects on learning performance. This conjoint influence could also focus on the interactions between (clusters of) intrapersonal factors and situational factors (e.g., context, content, and task factors). For example, by conducting a moderator analysis in—the currently underrepresented educational levels—primary and secondary education in the upcoming 15 years to examine the conjoint influence of (clusters of) intrapersonal factors or feedback-seeking (behaviours). Furthermore, future research can focus on examining whether there is a some sort of maturation involved in feedback-seeking behaviour, or that engaging in feedback-seeking is a matter of education or training (or a combination). This provides valuable insight into the design of education or training regarding feedback-seeking behaviour. Furthermore, it provides insight as to when it is essential for learners to be confronted with feedback-seeking activities.

In response to the lack of training in the processing of instructional feedback (see *Chapter 3*), future research could focus on embedding a feedback training, in particular in the area of expository text comprehension in DLEs. This training could, for example, focus on providing multiple opportunities to practice seeking, processing, and acting upon instructional feedback (Carless & Boud, 2018), and feedback messages that contain surface and deep-processing strategies (i.e., metacognitive reading strategies and motivational facets).

In addition, feedback research could benefit from adopting an integrative approach by triangulating measures to gain more insight in seeking and processing of instructional feedback. For example, by using qualitative methods such as think-aloud and semi-structured interviews, to complement quantitative methods. The digital setting is also suitable to use eye-tracking to tap into the attention and focus of learners during, for example, expository text reading. Similarly, feedback research could focus more on the degree to which self-reported feedback-seeking resembles actual feedback-seeking behaviour, because this provides insight in whether self-report questionnaires are valid measures of feedback-seeking behaviours.

Finally, viewing the learner as an essential part of the feedback process requires that the role of emotions is explored. Emotions are highly relevant for future learning and behaviour (Goetz, Lipnevich, Krannich, & Gogol, 2018); however, emotions are often excluded in the feedback literature (see e.g., Hattie & Timperley, 2007) whereas feedback is mostly excluded in the emotion literature (Goetz et al., 2018). Because the aspects that evoke emotions can inevitably vary in education, with not all emotions being equally relevant (Lehman, D'Mello, & Graesser, 2012), complex processes of emotional transmission may be present in the seeking and processing of instructional feedback. Which emotions and how emotions influence receiving or seeking instructional feedback when working in DLEs can be a topic for future research. In addition, clarification is necessary of the conceptualization of emotions evoked with digitally delivered instructional feedback as something additional or as part of the cluster of intrapersonal factors motivation.

Implications for Research and Practice

First of all, I hope that my dissertation raises awareness that seeking or receiving digitally delivered instructional feedback should not be approached from a one-size-fits-all perspective, and that instructional feedback—despite the possible emotional luggage—is not a bad thing. Second, learners have to be viewed as having a (pro)active role in which the internal processes are of utmost importance for seeking, processing, and acting upon instructional feedback. Especially in the context of expository text comprehension in secondary education—a context where digitally delivered feedback can help learners to overcome challenges and support them in building a coherent mental text representation—practitioners need to view instructional feedback as part of the learning process and prompt learners to seek feedback. As Stringer and Mollinaux (2003) explicitly stated: “if we get away from the notion that difficulties or gaps signal inadequacy, then we collaborate and share complementary strengths with our reluctant readers” (p. 72). Third, because learners are not always skilful in implementing instructional feedback, a training might be necessary. Such a training should not focus on expository text comprehension, but include perceptions of digitally delivered instructional feedback as being a part of the learning process, and how learners can bridge the gap between the current and desired level of comprehension with the help of metacognitive reading strategies (global reading strategies, support reading strategies, problem-solving strategies), and motivational and emotional facets (task-value, self-efficacy, control of learning beliefs), presented in mandatory or optional informative feedback.

