There is a preponderance of evidence that feedback is a powerful influence in the development of learning outcomes. Two findings from the many meta-analyses relating to the effects of feedback are most fascinating—the average effects of feedback are among the highest we know in education, and feedback effects are among the most variable in their influences. From a review of 12 meta-analyses that have included specific information on feedback in classrooms (based on 196 studies and 6972 effect-sizes) the average effect-size was $d = 0.79$, which is twice the average effect (Hattie, 2009). This places feedback among the top 10 influences on achievement. The variance of effects was, however, considerable, indicating that some types of feedback are more powerful than others (Kluger & DeNisi, 1996). It appears that merely prescribing lots of feedback does not imply that learning will take place, as one has to take into consideration the differential effects of feedback on learning as well as learners.

An accompanying finding is that although feedback is frequently provided in typical classrooms, much of this information is poorly received and hardly used in revision of work (Carless, 2006). William (2011) notes that written feedback in the classroom is often accompanied with a grade, yet historically studies (Butler & Nisan, 1986; Thorndike, 1933) have found that the provision of a grade can have a deleterious effect on the comment being received by the learner. Most verbal teacher feedback is presented to groups and so often students do not believe that such class feedback is relevant to them. Carless (2006, 2011) also has shown that teachers consider their feedback far more valuable than the students do; students often find teachers’ feedback confusing, non-reasoned, and not understandable. Sometimes students think they have understood the teachers’ feedback when they have not, and even when they do understand they claim to have difficulties in applying it to their learning (Goldstein, 2006; Nuttall, 2007).

The research on feedback has been focused predominantly on findings about its effects, whereas it is time to see how feedback makes a difference in classrooms. Although researchers are beginning to see the impact of feedback from a multidimensional perspective, more work needs to be done to explore effective feedback strategies in relation to individual learner characteristics (such as learner dispositions at the early
learning, proficiency or expert stage of learning); the active engagement of feedback with learners in terms of cognitive, metacognitive and motivational variables; and the nature, frequency and timing of feedback (Narciss, 2008). It seems we know so much about the power of feedback, but too little about how to harness this power and make it work more effectively in the classroom.

The first part of this review outlines five major learning perspectives that can help frame research in feedback and provides key studies to illustrate how different assumptions of learning and learners can influence the way feedback is construed and incorporated into the teaching and learning process. This sets the scene for the second part of the review, which considers feedback as helping make teaching and learning “visible.” This part highlights the power of peer feedback; the mindsets of teachers when giving feedback, particularly when they are receiving and seeking feedback; and the role of praise. It also considers the mechanism of developing teacher-student relationships that lead to trust in students acknowledging error and misunderstandings, which then permits feedback to be effective. Central to this review is the observation that: (a) feedback is a consequence of instruction and it is more productive to consider when and how it is received rather than when or how it is given; (b) feedback is powerful when it makes the criteria of success in reaching learning goals transparent to the learner; (c) feedback is powerful when it cues attention of the learner to the learning task, task processing strategies and self-regulation strategies instead of attention to the self; (d) feedback should be calibrated to engage learners with the learning task at, or just above, the level where the learner is currently functioning; (e) feedback should challenge the learner to invest effort in setting and monitoring learning goals; (f) the learning environment should be open to errors and disconfirmation; (g) peer feedback provides a platform for engaging students in interactive and elaborative feedback discourse as well as taking ownership of their learning; and (h) feedback should also cue teachers’ attention to errors in their own instruction so that modifications can be made to improve teaching and learning.

THEORETICAL PERSPECTIVES OF LEARNING AND THEIR RELATION TO FEEDBACK

Feedback can serve different functions depending on the particular learning perspective under which it is viewed and the underlying assumptions about the learning context on which research in these areas are based (e.g., Thurlings, Vermeulen, Bastiaens, & Stijnen, 2013). This part of the review considers five major perspectives—objectivism, information processing, socioculturalism, neuroscientific, and visible learning theory—that provide the frameworks for describing different views of learning and the nature of feedback when viewed from that learning perspective (see Table 14.1).

Objectivism

Objectivism takes the view that “reliable knowledge about the world” exists (Jonassen, 1991, p. 8) and instruction based on this assumption is seen as predominantly reception-transmission (Askew & Lodge, 2000). From an epistemological view, objectivism is a mirror image of reality created by the mind and these representations of the real world constitute the way of knowing (Lakoff, 1987). The traditional learning theory paradigm of behaviorism adopts this objectivist perspective and most feedback
<table>
<thead>
<tr>
<th>Philosophical Perspective</th>
<th>Assumptions</th>
<th>View of Learning</th>
<th>Nature of Feedback</th>
</tr>
</thead>
</table>
| **Objectivism**—reliable knowledge of the world exists | • All reality consists of entities  
• The entities, their properties and their relations make up our world  
• This reality exists outside of the individual  
• The mind functions to create representations of these entities and learning involves knowing these correct representations | • Behaviorist  
• Three types of learning respondent learning, operant conditioning and observational learning  
• Social-behavioral | • Feedback is external response which may contain symbols that match an external entity  
• Feedback reinforces current representations or corrects misrepresentations of this external entity (by providing corrective information) |
| **Information processing**—each learner constructs his or her own reality through processing and interpretation of experiences of the external world | • Reality is an interpretation based on an individual’s experiences  
• Learning takes place through individual meaning construction or cognitive activity when an individual tries to make sense of the world | • Information-processing  
• Cognitive elaboration  
• Self-regulated learning | • Feedback helps learners in processing information and meaning construction  
• Feedback is used to build internal understanding through connections with learner’s prior experiences, mental structures and beliefs |
| **Socioculturalism**—knowledge creation is a shared rather than an individual experience | • Reality exists through individual as well as being shaped by society and an individual’s relationship with society  
• Learning involves social negotiation of meaning | • Vygotsky’s zone of proximal development | • Feedback is a social negotiation through the meaningful use of language  
• Feedback involves a reciprocal and dialogic process of co-construction of meaning  
• Feedback quality depends on the interaction process of peers and not just the person providing feedback |
| **Neuroscientific perspective on learning**—poses questions such as: What is the nature of neuroscientific discovery? What is the nature of neuroscientific explanation? | • A reductionist theory assumes that something exists providing it can be reduced to its simpler components  
• A mechanistic theory, conversely, seeks to explain reality through explaining mechanisms and their causes  
• Learning involves changing the brain by making neural connections and networks to enable memory recall | • Hebb’s Law: “Neurons that fire together, wire together.” The brain develops neural networks to process and learn new information  
• Plasticity: The embedded neural networks of the brain change as new information is processed and stored in memory | • Feedback is also known as reinforcement learning  
• The neural transmitter dopamine is central to providing increased or decreased levels of reward to the brain  
• The brain becomes increasingly proficient at encoding particular actions with rewards  
• The disjuncture between the predicted and actual reward is causal to the dopamine response |
<table>
<thead>
<tr>
<th>Visible learning and teaching—</th>
<th>Knowledge creation is an individual, shared, and interactive process</th>
<th>Hattie &amp; Timperley’s levels of feedback</th>
<th>Feedback is a social negotiation through the development of cognitive and evaluative skills in developing understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>knowledge creation is based on</td>
<td>Reality exists through developing evaluative criteria as the veracity, worthwhileness, or integrity of the individual’s experiences</td>
<td>Feedback involves an explicit and conscious discourse with attention to assimilation, accommodation, and evaluation</td>
<td>Feedback quality depends on the changes to teaching and learning strategies of the teacher, learner, and peers to effect the learning goals</td>
</tr>
<tr>
<td>developing strategies of learning used to regulate understandings</td>
<td>Learning involves social and evaluative negotiation of meaning</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
studies in the earlier literature have examined feedback within this philosophical viewpoint (Mory, 2004).

From a behaviorist perspective, learning is viewed as conditioning where behavior that is followed by a reinforcer will increase in frequency or probability (e.g., Skinner's operant conditioning). Learning is seen as a process of reinforcing knowledge acquired in a sequenced and hierarchical fashion and learning tasks can be preplanned, organized, and programmed with specific outcomes defined. The learning task is analyzed to identify the components that must be acquired in order to complete the task and the most appropriate sequence of learning is prescribed based on observable learning outcomes. Feedback is usually seen as reinforcement, aimed at helping the learner to progress from a hierarchy of simple to more complex task performance. The objectivist roots are evident, with feedback provided from an external source (usually from the teacher who is viewed as an expert) in order to match an external learning outcome to the learner's current observable performance on the prescribed task. The dominant feedback discourse is one of reception-transmission (Askew & Lodge, 2000) and a prevalent view of feedback is that it serves as a motivator or incentive for increasing response rate and/or accuracy (Kulhavy & Wager, 1993).

A classic example of this instructional approach is the programmed instruction of the 1960s—depending on the answer to a question, the student is directed to remediation or to more difficult questions. Although it can be argued that feedback as reinforcement is beneficial to novice learners on new learning tasks, its effects are limited and at times confusing (Kulhavy & Wager, 1993). The focus on incentives may distract learners from the instructional content of feedback and results in little effort used to interpret feedback for learning (Kulhavy & Wager, 1993). Anderson and his colleagues (1972) found that students usually bypass the feedback if the answer is readily available in the learning task and when feedback is provided prior to completion of the task, students tend to copy their answers from the feedback instead of processing the feedback information meaningfully. This finding points to the importance of providing feedback after students have worked on the learning tasks and not before it; so that their attention is on how to use the feedback to revise their work.

The view that feedback serves as a motivator or incentive for learning is still prevalent in the classrooms of today and there remains a perpetual confusion between praise and content-related feedback (Hattie & Timperley, 2007). Deci, Koestner, and Ryan (1999) found that when teachers provide tangible rewards as a form of feedback, intrinsic motivation is significantly undermined and students are less inclined to take responsibility for motivating or regulating themselves. Feedback as extrinsic rewards often led students to place more emphasis on incentives, which result in greater surveillance, evaluation and competition, rather than enhanced engagement in learning. Kulhavy and Wager (1993) suggested that motivational variables be separated from the feedback message, in order to focus on the instructional content of feedback.

**Information-Processing Perspective**

The information-processing perspective of learning may be seen as a transition phase from behaviorism to socioculturalism and represents a shift in emphasis from an external view toward an internal view. An important feature of information-processing theories is that they recognize the cognitive ability of individuals to use information...
actively when engaging with the learning task. This suggests that feedback functions not only to reinforce correct answers but also as corrective information to help learners to correct his or her errors. The feedback-as-information position asserts that correction and analysis of errors are crucial components of learning and feedback acts as verification of a learner’s response certitude or level of certainty (Kulhavy & Stock, 1989).

For example, Kulhavy and Stock’s (1989) Response Certitude model suggested that an instructional feedback message contains two important components: verification and elaboration. Verification is defined as a dichotomous judgment to indicate whether a response is right or wrong. Elaboration is the component of the feedback message, which contains relevant information to help the learner in error correction. Feedback elaboration can be classified based on the type of information included: (a) task specific, (b) instruction-based, and (c) extra-instructional. Task-specific elaborations include restatement of the correct answer or inclusion of multiple-choice alternatives as part of item feedback. Instruction-based elaborations provide explanations of why a certain response is correct or re-presentation of the instructional text in which the right answer was contained. Extra-instructional elaboration refers to new examples or analogies not found in the instructional text. Besides the type of information, elaboration can take different forms, which refer to changes in stimulus structure between instruction and the feedback message. The load of an elaborative feedback is the total amount of information contained in the feedback message.

In this model, the feedback process is composed of three cycles, in which each cycle involves an external stimulus, learner comparison of the input to a reference standard, followed by a resultant response. The first cycle describes the learner as comparing the perceived task demand against previous experience and evaluates various response possibilities. The second cycle involves feedback processing by the learner. Here the learner’s level of certainty (response certitude) is arguably related to the discrepancy between perceived stimulus and reference standard results. According to the authors, when learners are certain their answer is correct (high certitude correct with low discrepancy), they will spend little time analyzing feedback, and verification feedback is sufficient. When learners are certain their answer is correct but it was in reality an incorrect response (high certitude correct with high discrepancy), elaborate information in feedback is useful to the learner, who will spend more time reviewing feedback. For learners with low-certitude responses, they would more likely to benefit from feedback that acts as new instruction.

Cycle three involves the learner responding to the same task after processing the feedback, and it is the aim that the corrective feedback now leads to a correct response (see also Kulhavy et al., 1990). Heubusch and Lloyd (1998) reviewed 24 studies on the effect of corrective feedback on reading comprehension. They found that there were some common characteristics such as correcting errors immediately, requiring students to repeat the correct response, and teachers should not be hesitant in interrupting the reading process to provide effective correction. Although this model is built around experimental testing environments that are unlike the typical classroom-learning situation, it supports the notion of learner involvement in the feedback process and highlights the need for adaptive use of feedback information with consideration to learner characteristics—in this case, high or low confidence in responding to questions.

Taking a step further, Bangert-Drowns et al. (1991) proposed a five-stage model of mindful feedback. This model suggests that feedback that encourages learner’s mindful reflection is beneficial to learning. Although the model explicates the need for
reflection on the part of the learner, the main focus of feedback is to change the current behavioral and cognitive state of the learner. For feedback to promote learning, it has to be designed to bring about mindfulness and to minimize mindlessness, such as providing feedback before learners begin their memory search for an answer.

Another feedback framework that takes on an information processing perspective is the feedback intervention theory by Kluger and DeNisi (1996). This theory suggests that feedback intervention that focuses the learner on the learning task results in a larger learning gain than feedback that draws attention to the self, which, on the contrary, can be detrimental to learning. It follows that when individuals receive norm-referenced feedback that compares their performance to lower achieving learners, they may attribute their poor performance to a lack of ability. This leads to decreased expectancies in future performance and lower motivation on future tasks. Kluger and DeNisi (1996) argued that there were three classes of variables that determined the effect of feedback on performance: the cues of the feedback message, the nature of the task performed, and situational and personality variables. Feedback can provide cues that capture a person’s attention. The central assumption is that feedback information gets a person’s attention, and that attention is hierarchical in nature. Of the many goals of feedback, it certainly can direct attention to the processes to accomplish the task, provide information about erroneous hypotheses, and be aimed to be motivational so that students invest more effort or skill in the task. Feedback effectiveness decreases as attention moves up the hierarchy closer to the self and away from the task. Therefore, feedback that directs its attention to the meta-task goals may lead to disengagement from the task even when the feedback is positive. A major key to unlocking the power of feedback is to ensure the cues are responsive to the task performed and that any provision of these cues considers the situational and personality attributes of the receiver.

Butler and Winne (1995) proposed an examination of feedback that takes into account how internal and external feedback affects self-regulated cognitive engagement with tasks and how different forms of engagement relates to achievement. They argued that feedback serves a multidimensional role in knowledge construction, which translates into a model involving self-regulation. This helps to extend the traditional view of feedback as predominantly seeking a set of correct responses or error-correction to one in which feedback is seen as a function of regulative cognitive process of the learner and is both dependent and a resultant of self-regulated learning. Internal feedback is generated when self-regulated learners monitor their processes of task engagement (e.g., setting goals, applying strategies or reviewing products of learning). This internal feedback provides information for the learner to regulate his or her task engagement and may be further influenced by external feedback, motivational beliefs and affective reactions. When there is a perceived discrepancy between a current state and the desired goals, internal feedback allows the learner to decide whether to invest further effort, modify their plan or abandon the task completely. The result of this cognitive monitoring and processing is the possible change in knowledge and beliefs, which, in turn, might further influence subsequent self-regulation (Butler & Winne, 1995).

Feedback as self-regulation recognizes the importance of interaction between feedback information and the receiver, and further emphasizes the active engagement of the learners in cue-seeking as well as monitoring and evaluating their own performance. For example, Butler and Winne (1995) postulated that feedback which helped learners see the link between cues and performance would improve the accuracy of judgments about their own performance, a process known as calibration. Learners are said to be well calibrated when they are able to “self-regulate by recursively adjusting approaches
but based on perceived task cues in relation to achievement” (p. 251). Citing the study by Balzer et al. (1989), Butler and Winne argued that cognitive feedback may enhance learners’ calibration by monitoring cues such as task features or cognitive activities, which is a necessary part of self-regulation.

Butler and Winne (1995, p. 250) further asserted that learners’ “beliefs about learning affect self-regulation by influencing the nature of and interpretation of feedback.” Explicating from two lines of research—Schommer and her colleagues’ (1992) research on learners’ epistemological views about learning and Chinn and Brewer’s (1993) review that identified seven ways that learners respond to anomalous information—Butler and Winne acknowledged the need to interpret feedback in light of the learners’ beliefs and knowledge domains. In summary, Butler and Winne (1995) concluded that the learner’s prior knowledge, beliefs, and thinking act as a filter to mediate the effects of externally provided feedback as well as internal feedback. This mediation, in turn, influences the learner’s monitoring of task engagement and progress, which is an inherent part of self-regulated learning. The explicit emphasis on the role of monitoring and feedback within a self-regulated learning framework broadens the objectivist conception of feedback to include the viewpoint of information processing, and hence, “integrates instruction, self-regulation, feedback, and knowledge construction” (p. 275). What is also evident from this synthesis is the acknowledgment that learners are not passive receivers of feedback but actively interpret feedback information through self-regulatory processes and have the capacity to be responsible for their own learning.

Narciss and Huth (2004) suggested a content-related classification of feedback in terms of the instructional context that is addressed by simple or elaborated information. In general, they claimed that designing and developing effective formative feedback needs to take into consideration the instructional factor or context (e.g., instructional objectives, tasks, and errors), learner characteristics (e.g., learning objectives and goals, prior knowledge, skills, abilities, and academic motivation), and feedback elements (e.g., content of feedback, function and presentation). Further, by combining elaborated feedback, tutoring, and mastery learning strategies, the informative value of the feedback could be enhanced. Narciss (2008) used the term informative tutoring feedback to refer to feedback strategies that provide elaborated feedback components to guide learners toward successful task completion. The elaborated feedback information may take the form of: (a) task rules, task constraints, and task requirements; (b) conceptual knowledge; (c) errors or mistakes; (d) procedural knowledge; and (e) metacognitive knowledge. Feedback as tutoring is focused on guiding students in error detection, overcoming obstacles, and applying more efficient strategies for completing the learning tasks (Narciss, 2008).

Socioculturalism

Feedback may be seen as performing a wider function in helping learners when viewed from a sociocultural perspective. The sociocultural view derives from the work of Vygotsky (1980, Vygotsky, Hanfmann & Vakar, 2012), who advanced a view that knowledge and understanding is socially constructed through interactions with others. For Vygotsky, the learner’s interactions with other people, preferably a more competent member of the society in which the learner is growing up, initiates the learner into the social, linguistic practices and artifacts of the society. Through participating in the cultural life of the community, the learner is seen as engaging in a kind
of cognitive apprenticeship, which helps him/her to acquire the ‘cultural tools’ that permit the learner to develop more advanced level of thinking and conscious control over his or her mental processes. According to Vygotsky, the processes of interaction between the learner and others become internalized as the basis for intramental reflection and logical reasoning. Thus, learning and development are seen as mediated by the dialectical relationship between interpersonal and intrapersonal processes (Mercer & Littleton, 2007).

Research conducted by Villamil and Guerrero (2006) provides some insights into situating feedback within a sociocultural framework. Through a long-term study of peer feedback and revision, the authors found that individual development in second language could be enhanced by the social experience of talking about writing, as well as writing and revising with a partner. Five classes were taught how to revise their writing, and the first drafts were collected and then randomly paired. Students worked in pairs to revise these drafts (one working as the writer the other as the reader). The analysis of student interactions revealed that the peers needed to be at similar stages of self-regulation and shared control, as well as having high levels of empathy when listening to the partner’s comments. Through this process the students were able to discuss textual problems, acquire strategic competence in revising a text, acquire a sense of audience, and develop their own sense of regulation about their own writing. Although the study recognized the beneficial effect of peer interaction in learning, the authors noted the necessity to prepare and instruct learners on desirable behaviors such as maintaining mutual cognitive engagement and minimize negative behaviors that would impede collaborative learning.

The authors recommended the need for educators to be aware of the learners’ strategic behaviors that may influence the success of scaffolding during peer feedback and to explicitly address the learners’ sociocultural contexts and learning backgrounds to enhance collaborative learning in the classroom. They concluded that the exchange of ideas amongst peers resulted in consolidating, reorganizing and making knowledge explicit for the development of writing skills and discourse strategies. An important implication for feedback is the need to address the sociocultural differences of learners, which may take the form of social relationships, cultural norms, and behavioral expectations (see Pryor & Crossouard, 2008). For example, the nature of the teacher–student/student–student relationships may influence the level of acceptance of feedback by students as well as their involvement in seeking feedback (Bell & Cowie, 2001).

A Neuroscientific View

A neuroscientific view of learning moves away from sociocultural perspectives and aligns more closely with behaviorist views of objectivism, where learning or conditioning is dependent upon rewards. Educational neuroscience is an emerging field (Pasquinelli, 2012) and one of its aims is to connect neurology, psychology, cognitive science, and education to promote an evidence base to inform teaching and learning (Fischer, Goswami, & Geake, 2010). Learning involves physically changing the brain and as such, it is vital to gain deeper insight into the role of these neural mechanisms in mediating learning (Blakemore & Bunge, 2012). A key enabler of neuroscience’s propensity to understand learning has been recent advancements in imaging technology. Neuroimaging allows scientists to “peer into the learning brain for the first time” (Hinton, Miyamoto, & della Chiesa, 2008, p. 87), although Pasqualiani (2012) cautions us to avoid the many neuromyths which may abound due to the growing public appetite for neuroscientific findings.
Within neuroscience, the process of learning from feedback is more commonly referred to as reinforcement learning, which is based upon the principle that when reinforcers or rewards follow favorable actions, then those actions are more likely to be repeated (Behrens & Jocham, 2011). The neurotransmitter dopamine has been identified as central to providing a global reward to the brain (Schultz, 2015). In short, dopamine spikes increase when a reward exceeds expectations and decrease when a reward is below expectations (Behrens & Jocham, 2011). While reinforcement learning has evolved from behavioral models (Montague, 2013), Behrens and Jocham (2011) remind us that the notion of rewards following actions remains a key tenet of human behaviour.

A key pillar of reinforcement learning is that as the learner becomes increasingly proficient at encoding particular actions with favorable rewards, she or he can shift the time of the dopamine spiking to before the event, therefore predicting what is yet to occur (Schultz, 2015). In this sense it is not solely the reward or punishment itself that influences a dopamine signal, rather it is the disjuncture between the predicted and actual rewards or punishments (Garrison, Erdeniz, & Done, 2013). This difference in expected and perceived rewards is known as reward prediction error (Behrens & Jocham, 2011). An unpredicted reward produces a positive dopamine response, a predicted reward produces no response, and an unrealized predicted reward diminishes the dopamine response (Daw & Shohamy, 2008).

The overarching premise for educators is that reward prediction errors can modify actions and, in turn, learning. However, the presence of covariates makes this somewhat problematic in how we translate this knowledge into the classroom. For instance, research on the temporal discounting of feedback by the learner has produced varied findings. There is evidence that student performance is augmented by immediate feedback rather than delayed feedback (Dihoff, Brosvic, & Epstein, 2012). Fajfar, Campitelli, and Labollita (2012) found that expectation of feedback can affect performance with participants who expected immediate feedback performing better than those who anticipated delayed feedback. Yet, studies have also shown positive relations between delayed feedback and the activation of lateral prefrontal and parietal areas of the brain that are associated with executive functioning (Lee et al., 2012). Further investigation of how the differences among learners affect their ability to receive and use feedback is also required. For instance, the academic motivation of the learner has been found to mediate temporal discounting (Lee et al., 2012).

Interestingly, Chiviacowsky and Wulf (2007) found motivation is in turn affected by feedback. In their experiment, feedback provided after good versus poor trials resulted in improved performance, and they concluded that feedback can have a motivational effect. Perhaps a powerful conception bridge could be to recognize that the brain is a very good error detector. It thus seeks feedback to make alterations to provide better predictability, ignores some feedback that is inconsistent with current beliefs, and makes more focus on the receiver to listen and interpret the feedback information. Thus more research is needed on optimal ways to help students receive and interpret feedback, how to modify their beliefs and understanding in light of the provided feedback; current research certainly highlights the importance of seeing feedback more in terms of the receiver, rather than the giver, and how the receiver reacts to feedback.

Models of Feedback from Visible Learning

The aforementioned perspectives suggest that there is a need for understanding the underlying assumptions that educators make about learning and how such assumptions
impact the way feedback is delivered and used. In classrooms, there may be a need to move from seeing the teacher as giver and the learner as receiver of feedback towards also accounting for the social context of learning, particularly the ways peers provide feedback. Thus, feedback needs to move from a predominantly transmission and verification process to a dialogic and elaborative process in a social context (e.g., Nicol, 2010; Tuck, 2012). In this way, feedback can be viewed within a context of student learning (with peers, with adults, alone), at varying stages of proficiency (novice, proficient, expert) and understanding (surface, deep, conceptual), with differing levels of regulation (by others, with others, self), and with differing levels of information and focus to the feedback information.

An important question is whether the feedback provided is meaningfully received, and then interpreted by a learner to some effect or not. We advance a further model based on making the visibility of the teaching and learning apparent to both the teacher and learner (or to the same person when the teacher and the learner are one). This model not only critically notes the social context of this visibility and the powerful part peers can play in the learning and feedback process, but sees the most impact relating to when the teacher (a more experienced person who could be adult or peer) receives feedback and thence changes or supports their teaching strategies with the resultant effect of improving learning.

The premise of the Visible Learning model is that feedback is most powerful when it makes learning visible to the teacher (who could also be the learner). The notion is that the teacher needs to construct environments and activities that optimize making the learning of the student visible to the teacher (and preferably also to the student). This means that the teacher needs to invest, modify, or enhance the probability of succeeding in making the intentions and success of the learning transparent to learner, as well as where on this trajectory the student is relative to the success of the learning goal (Hawe & Dixon, 2014). The key notions are that feedback is enhanced when the criteria of success in reaching the learning goal are most transparent, when students and teacher see sufficient challenge to invest in seeking and using the feedback to assist in reaching success, and when the feedback is sufficiently at or ahead of where the cognitive nature of the task is focused, and it addresses three major questions: Where am I going? How am I going? Where to next?

Such feedback often has to compete with many other cues for the student (e.g., completing the task with minimum effort, alternative cues from peers about how to reach success, not realizing the nature of what success in the task looks like, or even knowing when it is achieved). Hence, the social context can be critical when students interpret feedback. Most importantly, feedback is something that has its powers not so much when it is given or how it is given, but when and how it is received—it does not enter a vacuum but enters into a cycle of learning (e.g., from novice, proficiency, expert; from surface, deep, or conceptual; from being passively received to activity regulated into learning). The evidence for this model has been outlined based on a synthesis of 800 meta-analyses reported elsewhere (Hattie, 2009).

**CURRENT ISSUES AND TRENDS**

*The Goal Nature of Feedback*

Following Sadler (1989), Hattie and Timperley (2007) considered feedback to be information that aims to reduce the gap between what is now and what should/could be.
Specifically, we claimed that feedback is information provided by an agent (e.g., teacher, peer, book, parent, and self/experience) regarding aspects of one’s performance or understanding that reduces the discrepancy between what is understood and what is aimed to be understood. Today, we would replace “provided” with “received” as the research is showing that while much feedback may be given, it is how it was received, understood, and acted on that matters. So when a teacher or peer queries students’ work or provides information (either verbally or in writing) that helps students move from where they are in their knowledge or understanding closer to what is considered success at the task, then there is evidence of feedback. This feedback information could aid the student to increase effort, motivation, or engagement in the task. Or, such feedback could indicate the correctness or incorrectness of the student responding, explain that more information is available or needed, point to directions that the students could pursue, or indicate alternative strategies to understand particular information. Some key considerations are that feedback follows instruction, and thus is limited in effectiveness when provided in a vacuum. That is to say, feedback works optimally: (a) when there is a clear appreciation of both where students are currently at in the learning cycle and where they need to be; (b) when appropriately challenging tasks are used to optimize the probability that feedback could be valuable; and (c) when the current learning intent, goal challenge, and success criteria are transparent to both the teacher and the learner.

There is little research on how students set academic goals, and less on how to teach the setting of these goals. This is not to say they cannot set goals; indeed, many school age students often set goals in their sport or social endeavors. When they do set academic goals, these tend to be more performance or social than mastery oriented (Has-tie, 2009), such as completion of work, being on time, or trying harder. Similarly, the setting of more specific targets for academic goals is often done at the class but rarely at the student level. Smith (2009) asked teachers to set specific targets for secondary students based on students’ past performance and many teachers were reluctant to set goals as they claimed attaining them was not in their control (i.e., it was student effort and commitment that led to attaining goals not their teaching). Smith provided teachers with a trajectory of each student’s achievement over the past four years and then asked the teachers at the beginning of the year to set specific targets for each student at the end of the year. Those who set the targets compared to those who refused had greater success in academic achievement for their students (on an externally set of examinations), had different (more academic) conversations with students throughout the year, revised the targets upward with their students, and had a greater sense of agency in their teaching.

Along with appropriateness (i.e., relative to student’s past performance and attainable future), there are two further attributes of goals: challenge and commitment. Challenge relates to feedback in two major ways. First, challenges inform individuals “as to what type or level of performance is to be attained so that they can direct and evaluate their actions and efforts accordingly . . . Feedback allows students to set reasonable goals and to track their performance in relation to their goals so that adjustments in effort, direction, and even strategy can be made as needed” (Locke & Latham, 1990, p. 23). Second, feedback allows students (or their teachers) to set further appropriately challenging goals as the previous ones are attained, thus establishing the conditions for ongoing learning. By having clear goals, students are more likely to attend to reducing the gap instead of overstating their current status or claiming various attributions that reduce effort and engagement. Goal commitment, which refers to one’s attachment
or determination to reach a goal, has a direct and often secondary impact on goal performance.

There are many mediators that can affect goal commitment, such as authority figures, peers, peer pressure, role models, valence, public nature of goals, and ego involvement. Peers influence goal commitment through pressure, modeling, and competition, and particularly during adolescence the reputation desired by the student can very much affect the power of this peer influence (Carroll, Houghton, Durkin, & Hattie, 2009). A further consideration in the power of goals is the intention to initiate goal directed behaviors. Gollwitzer and Sheeran (2006) have shown how those students who have a planning mindset toward their goals are more open-minded, more successful, and have a more accurate analysis of information needed to achieve the goal. From a meta-analysis of 63 studies (n = 8461 participants) their overall effect was $d = 0.65$ of the existence of an implementation intention on the outcome, which is quite substantial. When forming implementation intentions, students are more open to feedback as to how to achieve the goals, particularly in an efficient, self-regulatory manner, and are able to reduce unnecessary disruptions.

Three Feedback Questions

Hattie and Timperley (2007) argued that feedback could be considered to relate to three major questions and four major levels of learning. Effective feedback needs to address three major questions asked by the teacher and/or by the student: Where am I going? (What are the goals?) How am I going? (What progress is being made toward the goal?) Where to next? (What activities need to be undertaken to make better progress?).

The first question, “Where am I going?” relates to goals and is also known as feeding up. When students understand their goals and what success at those goals look like, then the feedback provided is more powerful. Without such an understanding (and even better commitment to attaining these goals) feedback is often confusing, disorienting, and interpreted as something about the student rather than their tasks/work—or worse, seen as irrelevant, not understood, and ignored. For example, feedback can be provided about “where the student is going” via clear learning intentions and an outline of what success looks like when a student attains these intentions (at varying levels of success, e.g., not achieved, achieved, with merit, with excellence). Importantly, feeding up lays the platform for self-regulated learning. It is primarily through clarity of where they are headed and what success looks like that students can monitor their own progress.

The second question is more related to progress feedback: “How am I going?” This entails feedback (about past, present or how to progress) relative to the starting or finishing point and is often expressed in relation to some expected standard, to prior performance, and/or to success or failure on a specific part of the task. Feedback about “how am I going” relates to where on the path the student is placed on this process of learning, refers to the success and gaps in the learning, can involve comparative feedback (both normative and criterion referenced), can invoke personal bests, and typically requires a reasonably well understood sense of curriculum progression. Feedback can best be enacted once the student has been given an opportunity to demonstrate understanding. Formative interpretation, whether formal or informal, is an effective tool for teachers to generate feedback opportunities (Wiliam, 2011). Importantly, formative interpretations from assessment clarify for students both what the teacher is looking for and their current learning progress within the learning period. The very
nature of formative interpretations of assessment deems that further opportunities are provided to the learner to measure how they are going and, crucially, what they have to do to improve.

Thus, the third question is more consequential: “Where to next?” Answering this question requires the learner understanding “how am I going” (feedback) in relation to “where am I going” (feed-up). Thus this type of feedback aims to reduce the gap between where the learner is now and where they need to be, and is commonly referred to as feed forward. Effective feed forward is matched to the learning intent and more specifically the success criteria. Clear and explicit success criteria can be used constructively by teachers to aid students to meet or exceed the learning intent. Wiliam (2011) refers to the teacher, student and peers as resources that can be enacted within the classroom to provide feed forward to students. This diversified model of teaching is based upon the notion that it is unsustainable for the teacher to provide differentiated feedback to each student on an ongoing basis. Such feedback can assist in choosing next the most appropriate challenges, more self-regulation over the learning process, greater fluency and automaticity, different strategies and processes to work on the tasks, deeper understanding, and more information about what is and what is not understood.

Four Feedback Levels

Hattie and Timperley (2007; see also Hattie, 2012a) proposed that feedback may help learners to “reduce discrepancies between current understandings and performance and a learning intention or goal” (p. 6) by engaging learners at four different levels in which feedback operates. The four levels are task performance, processes of understanding a task, the regulatory or meta-cognitive process dimension, and/or the self or person (unrelated to the specifics of the task). Feedback has differing effects across these levels.

Task Level

Feedback can engage learners at the task level, such as providing information on correct response (e.g., “You explained the limitations but could have said why they were not reliable”). Such feedback can be about the task or product, and in this case feedback is powerful if it is more information focused (e.g., correct or incorrect), leads to acquiring more or different information, and builds more surface knowledge. This type of feedback is most common (Sheen, 2004); many teachers and students see feedback primarily in these terms (Peterson & Irving, 2008), and it is often termed corrective feedback or knowledge of results. It is constantly given in classrooms via teacher questions (as most are at this information level), it is often specific and not generalizable, and it can be powerful particularly when the learner is a novice (Heubuisch & Lloyd, 1998). When there is low task complexity, then Kluger and DeNisi (1996) argued that motivation increases performance, particularly when lower cognitive resources are needed, and if motivation is directed to external factors to the task, this may debilitate performance. Thus, reducing cognitive load when completing a task can allow for feedback to be more influential (positively or negatively). When task feedback moves from simple to more complex, provides additional information, and comes from a perceived reputable source, than it is more powerful. Most class group feedback is of this task type, and most individuals do not consider such feedback as pertinent to them (so it
can be given by the teacher and not received by the student). Having correct information is a pedestal on which the processing (level 2) and self-regulation (level 3) can be effectively built.

**Process Level**

Feedback can be aimed at the process level, such as providing task processing strategies and cues for information search (e.g., “You could show more why the test was fair by highlighting the control variables”). This second level is feedback aimed at the processes used to create the product or complete the task. Such feedback can lead to alternative processing, reduction of cognitive load, providing strategies for error detection, reassessment of approach, cueing to seek more effective information search, and employment of task strategies. Feedback at this process level appears to be more effective than at the task level for enhancing deeper learning, and there can be a powerful interactive effect between feedback aimed at improving the strategies and processes and feedback aimed at the more surface task information. In a series of studies where the clarity of goals and nature of process feedback was manipulated, Earley, Northcraft, Lee, and Lituchy (1990) concluded that: “process feedback interacted with goal setting to strongly affect the quality of people’s task strategies and information search” (p. 101). Feedback provided a cueing device about which strategies where more effective or not to attain the goal, and the more specific and challenging the goal the greater the effectiveness of process feedback. This kind of feedback can assist in improving task confidence and self-efficacy, which in turn provides resources for more effective and innovative information and strategy searching. Chan (2006) induced a failure situation and found self-efficacy was enhanced through the use of formative rather than summative feedback, and self-referenced rather than comparative feedback.

**Self-Regulation Level**

Feedback at the self-regulation level involves skills for self-evaluation, expanding effort in task engagement, or seeking further feedback information (e.g., “What would happen if you increase the temperature in your study?”). Such feedback can boost confidence to engage further on the task, assist in seeking, accepting, and accommodating feedback information, provide conditional knowledge in the form of reflective or probing questions, help increase the capability to create internal feedback and to self-assess, and lead to internal more than external attributions about success or failure. At this level, there are more direct links to the self as a learner and more information to guide the learner on when and where to select and employ task and process level strategies. This can be achieved through developing attributes of self-assessment, self-help seeking, self-appraisal, and self-management.

**Self-Level**

Feedback is seen as directed to the self, which, in most occasions, does not provide information on how to improve performance on the task (e.g., “well done”), and so often directs attention away from the task, processes, or self-regulation. Such praise can comfort and support, is ever-present in many classrooms, is welcomed and expected by students, but rarely does it enhance achievement or learning. When Kessels, Warner,
Holle, and Hannover (2008) provided students with feedback that included statements that teachers were proud of them, the students were found to have lower engagement and effort compared to those who received feedback without statements of pride. Similarly, Dweck (2007) notes that praise for intelligence produces a fixed mindset within the learner, which reduces learner confidence, persistence and motivation. Hyland and Hyland (2006) noted that almost half of teachers’ feedback was praise, and premature and gratuitous praise can confuse students and discourage revisions. Most often teachers used praise to mitigate critical comments, which indeed dilutes the effect of such comments. Praise usually contains little task-related information and is rarely converted into more engagement, commitment to the learning goals, enhanced self-efficacy, or understanding about the task. By incorporating self with other forms of feedback, the information is often diluted, uninformative about performance on the task, and provides little assistance to answering the three feedback questions. Wilkinson (1981) found a low effect-size for praise (\(d = 0.12\)), as did Kluger and DeNisi (1998; \(d = 0.09\)), and, in fact, the absence of praise has a greater impact on achievement (\(d = 0.34\)).

These four levels are an expansion of the model developed by Kluger and DeNisi (1996). They argued that the highest level, \textit{meta-task processes}, involves self feedback; their next level, \textit{task-motivation processes}, is akin to the self-regulation level; and their third level, \textit{task-learning processes}, has been separated into task and learning processes. Feedback is explicated to be powerful when it engages the learner with the learning task or goal at, or just above, the level where the learner is currently functioning. Thus, the challenge for educators is to provide \textit{calibrated} feedback that is designed to function at the appropriate operational level of the learner.

One instructional approach for promoting the awareness of different feedback levels and their appropriate use in learning is to support the feedback process (between peers or teacher-student) through the use of a graphic organizer (see Figure 14.1). The graphic organizer incorporates the three feedback levels to provide visual scaffolding that facilitates explicit and meaningful feedback discourse. Learners may use this organizer to formulate feedback, interpret the feedback received, and extend the use of feedback information to further their understanding. This graphic organizer provides a common platform for teachers and learners to engage in feedback discussion and elaboration, and may create opportunities for a more dialogic and visible feedback process (see Hattie, 2012b).

**The Interaction of Feedback and Student Dispositions**

Feedback is not only differentially given but also differentially received, and thus it is important to consider various interactions with person characteristics such as culture, influence of peers, and classroom climate. Luque and Sommer (2000) found that students from collectivist cultures (e.g., Confucian-based Asia, South Pacific nations) preferred indirect and implicit feedback, more group-focused feedback and no self-level feedback. Students from individualist/Socratic cultures (e.g., USA) preferred more direct feedback, particularly related to effort; were more likely to use direct inquiry to seek feedback; and preferred more individual focused, self-related feedback. Kung (2008) found that while both individualistic and collectivist students sought feedback to reduce uncertainty, collectivist students were more likely to welcome self-criticism “for the good of the collective” and more likely seek developmental feedback, whereas individualistic students decreased such feedback to protect their ego. Individualistic
students were more likely to engage in self-helping strategies, as they aimed to gain status and achieve outcomes (Brutus & Greguras, 2008).

Hyland and Hyland (2006) argued that students from cultures where teachers are highly directive generally welcome and expect teachers to notice and comment on their errors and feel resentful when they do not. This differential effect relating to the cultural attributes of the students can be used to optimize instruction, as Bishop (2003) has so successfully demonstrated. He and his team have developed specific models and methods for changing teacher mind frames and strategies to acknowledge the cultural attributes of students within a class. They have used observation schedules of the teachers’ interactions with students and visibly shown the teachers the nature, frequency and success of their interactions with students and how the feedback provided has or has not been received differentially by majority and minority students in the classes.

Feedback is often considered as something that occurs between teacher and student, but the influence of peers in the feedback cycle is often critical. Nuthall (2007), for example, conducted extensive in-class observations and noted that 80% of verbal feedback comes from peers and most of this feedback information is incorrect. There

---

**Table 14.1 Graphic Organizer on Feedback Levels and Question Prompts**

<table>
<thead>
<tr>
<th>Feedback Level</th>
<th>Question Prompts</th>
</tr>
</thead>
</table>
| Task Level                                       | - What did he/she do well?  
- Where did he/she go wrong?  
- What did he/she use?  
- How can he/she elaborate on the answer?  
- What is the correct answer?  
- What other information is provided?  
- What is the explanation for the correct answer? |
| Process Level                                    | - What are the relationships with other parts of the task?  
- What other questions can he/she ask about the task?  
- What other information is needed to meet the criteria? |
| Self-Regulation Level                            | - How can he/she monitor his/her own work done?  
- How does this compare to...?  
- What other information is provided?  
- What learning goals have you achieved?  
- How can he/she reflect on his/her own learning? |

---

Figure 14.1 Graphic Organizer on Feedback Levels and Question Prompts
is a need for much more research about how to teach and involve peers in the feedback and teaching process, and therefore ensure that their feedback is correct and assisting in closing the gap between current status and desired outcomes. Teachers who do not acknowledge the importance of peer feedback can be most handicapped in their effects on students, and interventions that aim at fostering peer feedback are needed, particularly as many teachers seem reluctant to involve peers as agents of feedback.

Nuthall (1999) argued that students’ learning in the classroom is shaped by their experiences within the context of three different worlds—the public world structured by the learning activities and routines the teacher designs and manages, the semiprivate world of on-going peer relationships, and the private world of the child’s own mind. He demonstrated that the assumption that “all students experience essentially the same activities in the classroom when carefully planned by teachers and thus, all students will translate these experiences into expected learning outcomes” does not hold true to the research findings (2007, p. 160). Instead, learner differences, as well as peer relationships and status, strongly influence their opportunities for more engaging learning experiences. Thus, teachers should consider the differences in background knowledge of learners, the power of peer relationships and status, and the need to constantly monitor students’ learning progress and respond accordingly. More importantly, because much of what students learn comes from their peers, teachers need to become “involved with the peer culture and to work with it to manage our students’ learning” and build a culture of learning in the classroom that entails “mutual respect and co-operation—a culture where everyone feels he or she has something to contribute to classroom activities, where everyone takes responsibility for learning” (Nuthall, 2007, p. 162).

One method to understand the importance of peer feedback is via investigating the collaborative discourse between peers (e.g., O’Donnell, 2006; O’Donnell & King, 2014; Nussbaum, 2008). Such discourse highlights that the one-way transmission model of teaching is not evident for most students, as they make emotional and social investments in learning, interact as much if not more with peers during the learning, and build understandings about what it is they are supposed to be learning/doing, how they are going, and where they go next in their learning (or not). For example, Webb and colleagues (2008) found that the levels and elaborativeness of explanations among students in collaborative groups predicted individual learning in mathematics, with the highest growth associated with those generating explanations. In a review on collaborative discourse and argumentation, Nussbaum (2008, p. 345) coined the term “critical, elaborative discourse” to emphasize the importance of students “considering different viewpoints” as well as “generating connections among ideas and between ideas and prior knowledge”—much coming from peer discussions (also see, in this volume, Chapter 18 on cooperative learning and Chapter 20 on discussion). Peers thus provide much feedback to each other by such elaborations and critical discourse. They are not merely providers of right/wrong feedback but interpreters of the usefulness of feedback.

Of course, not all students provide such elaborations or quality feedback (Lockhart & Ng, 1995; Strijbos et al., 2010). Often the more able, the more committed, and the more verbal students provide greater elaboration and critical feedback and thus, are more advantaged in peer interactions. Teachers may need to deliberately teach some students these skills, structure classrooms to share this expertise, and make specific interventions to ensure all students can benefit from these peer interactions. When ignored, the elaborations and feedback often are incorrect or misleading; the effects are
still powerful and teachers have an even more difficult task of moving students to the desired success outcomes (e.g., Ballantyne et al., 2002; Topping, 1998).

One method for peers to provide feedback is via assessment of others’ work, and there has been a recent resurgence in research relating to the positive effects of peer assessment (PA) on student learning (e.g., Dochy et al., 1999; Falchikov & Goldfinch, 2000; Topping, 2010; Van Zundert et al., 2010). Peer assessment involves students assessing the quality of their fellow students’ work and providing one another with feedback (Dochy et al., 1999). The important elements of peer assessment are that it involves students engaging in reflective criticism of the products of other students, providing constructive feedback using previously defined criteria, and consisting of one or more cycles of feedback with opportunities for revisions. It certainly can be plentiful. Ngar-Fun and Carless (2006) argued that involving students in peer assessment and peer feedback enables students to take an active role in the management of their own learning, helps to enhance students’ self-assessment skills, and can improve learning of subject matter (see also Boud et al., 1985; Boud et al., 1999). In contrast to comments provided by teachers, students can receive more feedback from peers and more quickly (Gipps, 1994).

There can be resistance from teachers toward peer assessment or student-provided feedback. Reasons for that resistance can be reflective of concerns about the reliability of students grading or marking, power relations among peers or with teachers, failure of some students to participate (social loafing) or to be unduly influenced by friendship bonds, and student collusion. Hence, the effective use of peer feedback often occurs following deliberate training of students in providing feedback to their peers, and by ensuring that peer feedback is integrated into the lesson in a deliberative and transparent manner. An example is the sharing of peer feedback through the use of rubrics that outline the criteria for success (Cho & MacArthur, 2010; Lundstrom & Baker, 2009; Min, 2005; Prins et al., 2006; Rollinson, 2005; Zhu, 1995).

For example, Sluijsmans et al. (2002) found that students who received training that involved providing feedback were more likely to use the criteria and to give more constructive comments (specific, direct, accurate, achievable, practicable and comprehensible to the peer) than the students in the control group who did not receive training. Similarly, Min (2005) indicated that students with extensive coaching in peer reviewing generated more specific and relevant written feedback on global features of their peer’s writing. Students were trained by observing an instructor demonstrate how to comment on a peer’s draft following a 4-step strategy (i.e., ask for clarification, identify a problem, explain the problem, and suggest possible revisions) and thereafter encouraged to apply the strategy in commenting on their peer’s writing. The analysis of a peer’s draft before and after training showed that students made more comments explaining problems (see also Van Steendam et al., 2010).

Nelson and Schunn (2009) investigated the effect of feedback features (e.g., type-praise, summary, identifying problem/solution, scope of problem/solution, localization of problem/solution, explanation of problem/solution) on mediators (e.g., understanding feedback and agreement with feedback) that were proposed to affect feedback implementation behavior (revision of draft writing). The authors analyzed 1,073 feedback segments from writing assessed by peers from an online peer review system and found that understanding the problem had implications for implementation. The student was more likely to understand the problem if a solution was offered, the location of the problem or solution was given, or a summary of the problem was included. Tseng and Tsai (2007) conducted a web-based peer assessment with tenth-grade
students (16-year-olds) involving three rounds of peer feedback and two rounds of modifications on their projects for a computer course. Peer feedback was coded based on Chi’s (1996) framework: corrective, reinforcing, didactic, and suggestive. Tseng and Tsai found that online peer assessment significantly enhanced students’ quality of projects and concluded that the learning in the peer assessment process comes from both students’ adaptations of peers’ feedback and their assessments of peers’ projects. Reinforcing feedback was found to be most helpful to promote quality student projects, but the reasons behind this were not provided by the authors (see also Gielen, 2007).

**Student Perceptions of Feedback**

An emerging field of research relates to how students perceive and receive feedback. It is well to provide much, appropriate, and just in time feedback, but how it is received is the critical part. Indeed, feedback is valued more by teachers than by students (Carless, 2006). Like all of us, students engage in selective listening and sometimes need to be primed to be receptive to feedback. Without doubt, however, the effects of feedback depend on the reactions of the recipients (Kluger & DeNisi, 1998). Students learn various responses to feedback that can neutralize, mask, or misinterpret the incoming feedback, such as only hearing the positive or self-enhancing feedback, failing to listen to the negative information, accepting the positive and scrutinizing the negative, coding the positive broadly and the negative narrowly, attributing the positive to self and the negative to anything else, misremembering feedback, and creating self-fulfilling prophecies (Dunning, 2005).

There has been debate about how students conceive the value of feedback. Nazif, Biswas and Hilbig (2004), for example, noted that while most students saw the value of feedback, they disagreed on the value of all feedback. Many students commented about the unclear nature of teachers’ feedback and saw teachers more as judges of their work than interested readers. Hargreaves (2011) noted that students saw the teachers as “postmen or postwomen” whereby teachers delivered comments on work that would soon end up in the rubbish bin or discarded. Higgins, Hartley, and Skelton (2002) noted that students perceive feedback negatively if it does not provide enough information to be helpful, if it is too impersonal, or if it is too general and vague to be of any formative use, and some lacked the ability to decode teacher statements and thus saw feedback as of little value. Weaver (2006) found that the majority of students were unsure of some of the common terms used in the provided feedback and that they had not received guidance on how to read and use feedback, and the majority were working through their course without a clear understanding of what was required to improve their expressed cognitive skills.

One of the strongest findings is that students want “where to next” feedback the most. For example, in Wiliam’s (2012) study, when students were asked about their perceptions of feedback, what they wanted to know most is how they could improve on weaker areas. Harks, Rakoczy, Hattie, Besser and Klieme (2014) reported that students preferred process oriented feedback (a strategy was provided for each weakness) to grade oriented feedback. The students claimed this preference was because it fed a perception of competence which leads to a positive change in their interest. Students preferred in-test comments directed at specific aspects of their work, with an overall summary outlining key strengths and weakness of their work and providing direction for future improvement (Sopina & McNeill, 2014). They want feedback that provides strategies to improve their work rather than just pointing out which areas are
unsatisfactory (Small & Attree, 2015). Such “where to next” feedback is not common (Peterson & Irving, 2008).

The sensitivity to feedback, particularly critical feedback, has been related to societal norms about whether schools are expected to encompass social attributions (as in many Western societies) or whether schools are expected to primarily focus on achievement outcomes (as in some Eastern societies). In the former, the students do not expect to receive critical feedback, which they see more as a statement about them as a person, whereas in Eastern societies, critical feedback has less to do with them as people but is considered important to improve learning (Holmes & Smith, 2003). Across all societies, high self-efficacious students can cope better with disconfirming feedback, are more likely to make more optimistic predictions about their performance after initial failure than after initial success, and are more likely to seek specific and critical feedback so as to excel at the tasks. Low efficacious students often react negatively to both positive and disconfirming feedback, and for these students positive feedback about initial success may be interpreted as confirming they had a deficiency that needed to be remedied. This can lead to further engagement to remedy this “deficiency” in order to reach a passable level of performance, which would afford protection against failure. However, over the long term, these students may avoid tasks and feedback following initial success because such success signifies they have already reached an adequate level of performance and further tests may disconfirm the (sometimes hard gained) favourable outcome. Any negative feedback for low efficacious students can lead to negative emotions, decreases in motivation for subsequent tasks, and greater attribution that any success is more a function of ability than effort.

**Praise and Feedback**

Praise involves a positive commendation of worth, or an expression of approval or admiration usually directed more to the person than to the work itself (Brophy, 1981; Kanouse, Gumpert, & Canavan-Gumpert, 1981). As with most humans, students claim to like praise, although more often they rate praise as not that effective or worthwhile to improve their work (Lipnevich & Smith, 2008).

There are many types of praise. Firstly, person praise refers to attribution messages directed to the ability or the more non-controllable aspects of a person (e.g., intelligence). Kamins and Dweck (1999) found that children who have been given person praise were more likely to show a pattern of helplessness when faced with later failure than those who had been given process praise. Students praised for their ability showed a more performance goal orientation and made ability attributions for their performance. Following failure problems, they showed less task enjoyment, less persistence, and poorer performance relative to children who were praised for their effect (or we would contend, not at all; Mueller & Dweck, 1996). Secondly, process praise refers to attributional messages directed to the more controllable and temporally more unstable attributes (e.g., good strategies, use of effort). The positive effect of process and effort praise can be limited when effort is overemphasised or if hard work results in failure. For adolescents, effort praise can signify a lack of ability and thus be de-motivating when the recipient believes in an inverse relation between effort and ability (Lam, Yim & Ng, 2008). For students with mastery goals (e.g., aiming to meet some success criteria, master the skills in the task), effort praise can be de-motivating, but for students with performance goals (e.g., beating other students, performing for extrinsic rewards) effort praise can be intrinsically
motivating (Koestner et al., 1987). Finally, efficacy praise may motivate to the extent that it leads the student to feel competent and efficacious. Praise that enhances competence primarily by making social comparison, however, may result in overdependence on normative comparisons and less perseverance when faced with setbacks (Henderlong & Lepper, 2002).

Ryan et al. (1983) in their meta-analysis showed that in all cases the effects of praise was negative on increasing the desired behavior. The effect for praise given for something other than engaging in the target activity (e.g., simply participating in the lesson) was $d = -0.14$ (see also Deci et al., 1999); praise given for doing or completing the target activity was $d = -0.39$; praise given specifically for performing the activity well, matching some standard of excellence, or surpassing some specific criterion ($d = -0.44$); and praise dependent on engaging in the activity but not necessarily completing it ($d = -0.28$).

The impact of praise is moderated by various factors, including fixed vs. growth mindsets. Dweck (2007) argued that those who have fixed notions of intelligence, learning and achievement are most concerned about how they are judged (smart or not). They repeatedly reject opportunity to learn if they make mistakes; when they make mistakes, they try to hide them and not see them as opportunities to learn; they are afraid of effort because effort makes them feel dumb (if you have ability, you do not need effort); and when they hit a setback, they decrease their effort. Growth mindset students welcome mistakes and learning; in the face of failure they escalate their investment in learning.

Secondly, self-enhancement and self-verification are moderators that impact praise. Swann and Brooks (2012) proposed that those with self-enhancement are motivated to increase the positivity of their self-views and consequently prefer favorable feedback, whereas those with self-verification are motivated to maintain stable self-views and seek feedback that is congruent with those views, even when they are negative. For self-enhancers, the desire is for confirmation praise more than information that could improve self-understanding (Colvin & Griffo, 2007).

A third moderator is age. Preschool and primary students tend to believe that effort and ability work together to produce achievement outcomes, whereas adolescents and adults believe effort and ability have a compensatory relation and that ability represents a maximum capacity (Henderlong & Lepper, 2002). Early adolescents are more likely to desire self-verifying feedback (Rosen, Principe & Langlois, 2013) and are more able to accept negative feedback regarding a self-perceived weakness than a self-perceived strength. They see praise for effort, however, as a sign of lack of intelligence. Hence, adolescents often devalue effort for relatively easy tasks because they view a high expenditure of effort as a sign of low ability. Thus, praise for effort can thus be damaging because it conveys a message of low ability.

A fourth moderator is the ease or difficulty of the task. Praise for success at any easy task leads to the conclusion that the person distributing praise perceives the outcome as due to high effort expenditure, because praise is contingent upon effort. High effort is the ascribed cause for success at any easy task when the student is perceived low in ability. Therefore, praise may function as a cue for inferring that the student ability is low (Meyer, 1992; Meyer, Mittag & Engler, 1986). Another factor is whether the praise is earned or not. A person who has acquired only very basic skills in a domain is unlikely to accept praise for high ability until more elaborate skills have been developed or greater success is achieved (Henderlong & Lepper, 2002). The praise has to be seen to be earned to have any effect. Most students prefer praise not to be public (69%)
or not to receive praise at all (17%; Burnett & Mandel, 2010; Merrett & Tang, 1994). This is probably because most praise is directed at students whom teachers perceived to be low in ability than at students perceived as high ability; similarly more criticism was directed at high than low ability students (McClure, et al., 2011).

Students can see praise as a subtle way to control them. When praise is seen by students as controlling, there is a negative effect on intrinsic motivation and this counteracts any positive effects of the information about the task or effort (Deci, Koestner & Ryan, 1999). Praise can instill a sense of contingent self-worth that leads to helplessness in the face of subsequent difficulties (Kamins & Dweck, 1999), and expected contingent praise may produce engagement for the sake of adult approval rather than for the sheer enjoyment of the activity itself (Henderlong & Lepper, 2002). Grusec (1991), for example, found a negative correlation between the degree to which mothers praised their 4-year-olds for achieving pro-socially and the degree to which their children actually behaved in a pro-social manner. Furthermore, students who received praise displayed increased negative responses to a single failure than those who did not receive praise. (Skipper & Douglas, 2012). Less effective teachers have been found to use more praise (Lepper & Wolverton, 2002), and teachers generally give more person oriented praise and less process praise to low than high self-esteem students (Brummelman et al., 2014), which may be counterproductive.

The major message seems to be not to mix praise with feedback about the content or understanding being learned as it dilutes the feedback message. Feedback effectiveness decreased when individuals received information containing praise or critical judgments as it moved students’ attention away from the task (Kluger & DeNisi, 1996). This is not suggesting that teachers should not praise students, but rather they should not mix it with information about the task. Praise unrelated to the task and not mixed with feedback information may be welcomed, and certainly students welcome such praise. This praise needs to be specific, sincere, accurate, earned, preferably unexpected, not exaggerated or contrived, more private than public, not include social comparison, and preferable relative to what a person does than a generalised set of approvals. “To employ praise in the belief or in the confidence that a pupil will be made thus to react, or to produce, maximally, is to proceed upon false assumptions, it to build on a foundation of clay” (Schmidt, 1941).

**Delayed Instruction, Productive Failure and Feedback**

There is a growing interest in research to examine the effects of delayed explicit instructions on students’ learning approaches by creating opportunities for students to explore on their own the underlying concepts and procedures of new learning material prior to direct instruction (Glogger-Frey, Fleischer, Grün, Kappich, & Renkl, 2015; Kapur, 2014; Loibl & Rummel, 2014). The learning design usually includes two phases. In phase one, students are encouraged to try to solve an unfamiliar problem in small groups, and in phase two, the teacher builds upon students’ initial solutions to introduce and explicate the canonical solution. According to Kapur (2015), this learning design often results in productive failure, which is grounded in the belief that “engaging novices to try, and even fail, at tasks that are beyond their skills and abilities can, under certain conditions, be productive for developing deeper understanding and learning provided one can build upon and learn from this failure” (p. 52).

For example, in a series of studies on productive failure, Kapur (2008, 2014, 2015) examined the effects of delayed introduction of cognitive guidance or structure, as compared
to direct instruction, on students’ (12–15 years old) generated solution to a novel mathematics problem that targets a concept new to the students. The students’ outcome measures were: procedural fluency, conceptual understanding, and transfer. The findings of his studies revealed that students in the delayed instruction condition tended to generate more solutions as compared to the direct instruction condition (even after factoring in mathematics ability), as evidenced in using and applying their own prior knowledge in an attempt to solve the problem. An analysis of the posttest performance, further suggests that students who struggled on their own to come up with more solutions performed significantly better on the procedural fluency, conceptual understanding, and transfer items than students who were taught how to solve the problems on the onset.

Contrary to the belief that direct instruction is a prerequisite for learning, the findings from productive failure studies suggest that the process of providing students opportunities to generate representations and solutions to a novel problem prior to instruction can be productive in preparing them to learn better from the subsequent instruction that follows (e.g., Holmes, Park, Day, Bonn, & Roll, 2014). This productive failure learning design draws a corollary to the notion of delaying feedback until the student has attempted the learning task, emphasizing the point that feedback is effective as a consequence of performance (Hattie & Timperley, 2007). When students tried and failed to arrive at the solution, they have the opportunity to work on finding out, understanding and constructing the success criteria (in this case, the critical features of the concept, and why it is formulated the way it is) for themselves, which makes the subsequent feedback from the teacher more meaningful as it allows for a comparison and contrast between the student generated solutions and the canonical solution. As Kluger and DeNisi (1996) noted, cues elicited from the learning task that support students in drawing their attention to feedback-standard discrepancies at the task level is likely to result in better learning gains. In other words, the students are able to use the feedback productively to close the feedback loop in their own learning. The challenge for researchers and educators is to design learning tasks that will help activate a “feedback loop” in the students, whereby students’ prior knowledge are made visible to themselves and allows for subsequent connections to be drawn from the feedback in relation to the initial attempt to come up with plausible solutions.

**Error Management**

Another emerging research domain relates to how students react to errors. Indeed, errors in learning can be opportunities, can be feedback, can lead to connections, can be a by-product of active learning, and can be most positive. They can also be upsetting, disruptive and frustrating, leading to lower motivation to engage and learn. Traditionally, the behaviourist approach equated errors with punishment that can inhibit behaviour and do not contribute to learning (Skinner, 1953).

When solving a problem, errors usually occur when students over-rely on easily obtained or surface information, ignore critical information and competing explanations, and apply incorrect but easily accessible strategies or old routines (Mumford, Blair Dailey, Leritz & Osburn, 2006). Students also tend to be over-optimistic about offered solutions, be reluctant to explore or analyse errors in detail, underestimate time and resources needed for solution and fall into the trap of over automization at an early stage of the problem-solving process.

Error management can lead to acquisition of stronger mental models and better performance (Ellis & Davidi, 2005). Students (and teachers) should be encouraged to
make errors during learning, particularly when they have multiple views, and when trust is high and the risk of ridicule and embarrassment is low. Errors may instigate exploration and creative solutions, and it can disrupt premature automatization of actions; the transfer of what one learns in training into the work situation is enhanced when the training methods allow errors to appear. A teacher’s inappropriate reaction to errors can increase student negative affect toward errors, reduce learning, and result in students avoiding engaging in challenging tasks. There can be major differences across cultures. Although US and Chinese students make approximately the same amount of errors, US teachers immediately correct them, while Chinese teachers ask follow up questions to promote student discussion (Tulis, 2013).

Keith and Frese (2008) conducted a meta-analysis based on 24 studies \( (n = 2,183) \). The effect-size was \(-.15\) within training and \(2.0\) on near transfer, possibly because it requires more resource demands on thinking and risk to self and thus may be less effective for lower than for higher ability students (cf. Loh et al., 2013). The effect-size was \(0.56\) on post-training transfer performance and \(0.80\) on transfer to new situation. It seems that errors are less effective with surface and more effective with deeper learning. Similarly, when the aim is to transfer learned skills to novel problems that require the development of new solutions, then the presence of errors is powerful. For such deeper and transfer learning, error learning can led to more errors (Oreyzi et al., 2013). Students can then use their mistakes to enhance their learning, which implies that teachers have to specifically provide error management to lower ability students. Error management training is most effective in an active exploratory mode, after students have sufficient surface level knowledge to so explore, when trying out ideas, when experimenting, and when trying to understand how they learn (Nordstrom, Wendland, & Williams, 1998). Such training consists of error diagnosis (i.e., detection), error identification, error explanation, and error recovery (i.e., correction) and both need to be supported, can be taught, and should be monitored to ensure students can use these strategies (Bettcher, Gionannetti, MacMullen, & Libon, 2008). Error training can lower frustration, enhance intrinsic motivation, promote requests for help, and lead to more mastery over performance alone, encourage effortful processing, and encourage a more active than passive approach to learning (Joung, Hesketh & Neal, 2006; Nordstrom et al., 1998). Those who can attend and welcome errors are more able to generate more appropriate alternative actions, identify more problems with their strategy, and more critically reflect on the procedures so far used (Joung et al., 2006). Teachers who provide opportunities to discuss student misconceptions and errors and encourage students to learn from errors by correcting errors themselves foster more adaptive ways of dealing with mistakes (Anderson et al., 2004; Meyer et al., 2006). For too many students, errors are not seen as opportunities for learning. Moreover, many teachers hold that errors have detrimental effects on students’ self-esteem, and therefore do not facilitate a learning environment where error is welcomed (Spychiger et al., 1998).

Making Feedback Useful for Learners

The growing emphasis of moving away from seeing assessment as a terminal activity to an integral part of teaching and learning recognizes the re-conceptualization of assessment feedback as a social, collaborative activity, formatively embedded in the learning process (Black & Wiliam, 2009; McMillan, 2013). More importantly, the focus is now on students taking greater ownership of their own learning through active engagement
in the feedback process and using feedback for self-monitoring and decision-making to improve learning (Ruiz-Primo & Li, 2013). To support students in using feedback, researchers have targeted the development of better learning design in the classrooms. For example, Carless, Salter, Yang and Lam (2011) suggest that feedback practices can be represented by a continuum ranging from conventional to sustainable feedback practices. Feedback provided at different points along the continuum is likely to serve different purposes. Feedback can be used retrospectively for error detection and correction, or it can serve the purpose of promoting future learning, a prospective view that involves learner engagement with feedback and practice over time.

Feedback can also be seen introspectively, whereby the learner uses feedback for self-evaluation and self-regulated learning. To help students take a greater role in their learning, tasks should adopt a two-stage (or multi-stage) design. This not only provides appropriate feedback but also teaches students to constructively receive and use the feedback in their learning. This approach also facilitates teacher-student feedback dialogue around the criteria required for achieving the final stage of the task. Other practical strategies to help students make sense of feedback and to use feedback effectively include the use of reflection sheets (Jackson & Marks, 2016; Quinton & Smallbone, 2010), a checklist with learning criteria (Mansour, 2015; Wakefield, Adie, Pitt, & Tessa, 2014) and interactive cover sheets (Bloxham & Campbell, 2010). These strategies require students to read, question, think and reflect about the feedback received, in relation to their work done as well as how to use the feedback in subsequent revisions. These tools also facilitate the two-way communication between teachers and students to explain and clarify the feedback and to help teachers in checking on students’ understanding, and to explore possibilities for improving instruction.

From the teacher’s perspective, feedback practices can be seen as dialogical processes, involving teacher–student or student–student elaboration, negotiation and resolution. If teachers view feedback as a product (an answer), this often results in passive responses, but when feedback is recognized as a social process or practice, it can provide opportunities for active participation through cognitive and relational engagement. In other words, there is a need to consider how teachers create the conditions for engagement, which, in turn, opens up choices for the learner to respond to the feedback. However, this notion of dialogic feedback may be challenging for teachers. For example, Parr and Timperley (2010) found that there is a strong relation between teacher ability to give quality assessment for learning feedback and student progress in writing. Teachers need to learn how to give feedback. They need to learn how to provide information to move the student forward along a progression, making this progression transparent to students, to notice an appropriate gap between what the students seem to know and where they need to go. Teachers should have the opportunity to work together to become clear themselves about their own views of the success criteria, to develop a deeper understanding of making reliable judgment of written work, how best to use diagnostic assessment tool rubrics to identify expected progression, and to examine closely and collectively samples of student work against specific criteria.

FUTURE DIRECTIONS AND CONCLUDING THOUGHTS

The major claim in this chapter is that feedback is related to the assumptions teachers have about the nature of feedback (often it is correct/incorrect), its purpose (learning, motivation), and the degree of visibility that feedback plays in the learning process.
(by teachers and by students). Feedback can indeed make the learning visible (e.g., via noting errors in thinking or fact), lead to error detection, and enhance students’ assessment capabilities about their learning. Central to these notions is a teacher–student relationship that not only permits but also fosters errors and the seeking of feedback, and classroom climates where peer assessment/feedback is a visible and important part of the learning for all students. Feedback is successful when it is aimed at or slightly above where the student is performing on the learning curve, from novice to proficiency to accomplished (the various levels), and there is a need to move from considering feedback as something that is *given* to something that is *received*. This means that more research is needed on how students understand and process feedback and less on finding ways for teachers to increase the amount of feedback they give. Feedback not received is unlikely to have any effect on learning.

We outlined five major perspectives of learning and their relation to feedback. Although not unique, the point of elaborating these perspectives is that teachers (and also students) can hold these views as if they are unique and thus restrict the power of feedback. The perspectives build on each other, although the Visible Learning (VL) mindset uses the notions from the objectivist models of feedback as reinforcer, motivator, verifier and elaborator; from the information processing models of feedback as modifier of the students’ understandings of their reality and knowledge, cognitive monitoring and self-regulation; from the socioculturalism model of feedback in a sociocultural context, the potential power of peer feedback, and understanding the gap between current and a more advanced or desired level; and from the neuropsychological view of feedback with the brain as a predictor of error. The VL model places more emphasis on the mindsets that the teacher and student bring to the learning process, the importance of teachers seeing their effects on the learning process and learner, and the value of encouraging students to see the power of teaching from others (e.g., experts or peers) and thus seek or receive feedback in their own learning. Feedback can serve all the above roles, but more importantly, the concern with feedback should be less whether it is given and more how it is received (by students and teachers). There is increasing evidence of the interactions between the type of feedback (task, process, regulation) and the level of proficiency of the student (novice, proficient, mastery). Moreover, there is greater understanding of the importance of studying the receiving more than the giving of feedback, and it is becoming clear that the (early) transparency and challenge of the goal is important for the effectiveness of feedback. The climate of the class is critical, particularly when there is high trust and a climate in which being wrong is seen as a positive part of the learning, and thence feedback can be sought when a student does not attain a goal.

The Visible Learning model, building particularly on Kluger and DeNisi’s (1996) seminal work, sees feedback as purposive (i.e., the three feedback questions), operating at different levels for different purposes, and being most effective when there is a high degree of transparency between the current status and the desired outcome to both teacher and student. Thus, there is a need to understand feedback within the context of students’ learning (with peers, with adults, alone), at varying stages of proficiency (novice, proficient, expert) and understanding (surface, deep, conceptual), with differing levels of regulation (by others, with others, self), and with differing levels of information and focus in the feedback information. The aim is to make learning (and feedback) as visible as possible in the classroom, acknowledging the dispositions of students and the power of peers in the feedback process. Indeed, more research on peer feedback (e.g., their discourse in class, peer assessment) could open up many exciting ways to maximize the power of feedback in classrooms (e.g., Gan & Hattie, 2014).
Table 14.2 Possible Research Questions: Feedback and Learning

What are the most effective ways (and conditions) to provide feedback?
What are the factors that affect the variability of the influence of feedback?
Why do students not see feedback as powerful in their learning as do the teachers?
How do students receive, understand and use feedback in their learning?
How can we use theories and research from the past 100 years to build more successful models of the how and why of feedback on learning?
How to use feedback more as reinforcement, cues for attention, and a motivator of learning?
What is the role of learner certainty in their response, reactions to error, and open-mindedness to receiving feedback?

The Multidimensional Role of Feedback
Should feedback be differentially provided according to the three fundamental feedback questions?
How to most effectively make the learning goals and success criteria transparent and realizable to students so as to maximize the effects of feedback?
What is the role that feedback takes relative to other learning dimensions (e.g., the role of cognitive load, cueing, attention, levels of understanding)?
What is the role of appropriate challenge in learning goals so that the influence of feedback is maximized?

Feedback to Teachers
What is the role of feedback in changing teacher behaviors and expectations?
How do teachers use feedback about the effects of their teaching to then alter their instruction?
What are the effects of target setting, on the basis of prior achievement, on teachers’ expectations and on success in their teaching?

Feedback to Students
What are students’ beliefs about feedback and how do these affect the power and direction of influence on learning?
How do students set performance and mastery goals in classes, and how then do these affect how they seek or receive feedback?
What is the role of goal specification, challenge, commitment, and implementation intention on the role and power of feedback?
What is the influence of culture on how feedback should be provided, and how it is received?

Types of Feedback
Is there a typology of feedback that can best relate to the differential effects on learning?
What are the effects of different forms and intensity of feedback relative to the varying stages of proficiency (novice, proficient, expert), understanding (surface, deep, conceptual), with differing levels of regulation (by others, with others, self), and with differing levels of information and focus to the feedback information?
Can we devise effective methods to assess the frequency, nature, and value of feedback in classrooms?

Feedback Levels
What is the differential impact of feedback relative to the four feedback levels (task, process, regulation, self)?
Is there an optimal balance of feedback relative to the four levels of feedback?
Why is praise so present, and are there ways to combine praise and feedback to have a positive effect on learning?

Peer Influences in Feedback
How to use peers to provide correct feedback to others in the classroom?

(Continued)
The current interest in teacher reflection often fails to take into account that so much in the learning process is unseen by teachers (and thus difficult to reflect about). Nuthall (2007) showed that about 70% of classrooms is not seen or heard by teachers, and this must means that many teachers may not be aware of student error, whether feedback is being sought or received, or the nature and power of the feedback effects, particularly when it has been provided by peers. Errors need to be welcomed in classrooms (by teachers, student, and peers). Feedback is most effective when we do not have proficiency or mastery. Thus it thrives when there is error or incomplete knowing and understanding (often there is little information value in providing task level feedback when the student is mastering the content). This means there need to be classroom climates where there is minimum peer reactivity to not welcoming errors, when evaluative salience of the self is low, and when there is low personal risk involved in responding publicly and failing (Alton-Lee & Nuthall, 1990).

Too often, students only respond when they are fairly sure that they can respond correctly, which often indicates they have already (partly) learned the answer to the question being asked or when they are not fearful of their peers’ reactions. Heimbeck, Frese, Sonnentag, and Keith (2003) noted the paucity of research on errors in classrooms, and they recommended that rather than being error-avoidant, training that increases the exposure to errors in a safe environment can lead to higher performance. Such an environment requires high levels of self-regulation or safety (e.g., explicit instructions that emphasizes the positive function of errors) for errors to be valuable, and it is necessary to deal primarily with errors as potentially avoidable deviations from goals.

Another major conclusion relates to the mind frames that teachers need to develop that they may be making “errors.” That is, teachers’ methods, strategies, and involvement in classrooms may not be assisting in student learning. Seeking feedback about their effects can be among the more critical methods for thus adapting instruction to better meet the needs of student learning. There is much still to understand, and Table 14.2 provides a compendium of questions that arise from this review. It is not that we do not know a lot—indeed, the research on feedback is now growing—but it is an attempt to outline the questions that derive from this review that can help move the field forward.

### NOTE

1. Acknowledgment to ARC-SRI: Science of Learning Research Centre (project number SR120300015)

### REFERENCES


Glogger-Frey, I., Fleischer, C., Grüny, L., Kappich, J., & Renkl, A. (2015). Inventing a solution and studying a worked solution prepare differently for learning from direct instruction. Learning and Instruction, 39, 72–87. doi:10.1016/j.learninstruc.2015.05.001


Loibl, K., & Rummel, N. (2014). Knowing what you don’t know makes failure productive. Learning and Instruction, 34, 74–85.


