The term ‘feedback’ emerged around the start of the 20th century. It was coined to describe mechanisms that would allow a well-engineered system to regulate itself (e.g., when a heating system exceeded a certain temperature it turned itself off, and could restart when the temperature got below a certain level). There is an inherent sense of control and automation within its original conceptualization. In reviewing the history of the social sciences, it is apparent that early behaviourists used feedback ideas extensively when attempting to analyse alterations in behavioural rates and probabilities. They conceived feedback as stemming from reinforcers (positive feedback) or in avoidance of punishment (negative feedback). The consequence of present actions would regulate changes in the rate of future action, in accord with the goal of servicing an organism’s motivational requirements, be they biological or socially defined. Irrespective of such uses, the term ‘feedback’ began to be used widely, becoming an aspect of everyday vernacular well aside from its original derivation in engineering theory and practice.

Today, feedback has come to have many more expansive meanings. For instance, there are distinctions between feedback and feed forward, and it can refer not only to actual consequences but can also be self-rewarding (i.e., feedback may inspire further actions and be intrinsically rewarding within itself). Certainly, our responsiveness to feedback is seen as a key driver of behavioural adaptation. This notion of sensitive and adaptive responsiveness was one of the initial ideas investigated through psychological science methods, often researched and documented under the term ‘knowledge of results’.

In broad perspective, it is not hard to locate convincing evidence pointing to feedback as a key process implicated in behavioural change. For instance, military gunners become more accurate and less wasteful in using ammunition when provided with detailed instruction coupled with feedback, both factors being essential (Gagne, 1962), young drivers become more careful after accidents or near accidents (Mayou, Simkin, & Threlfall, 1991), and entrepreneurs often report certain positive learning effects associated with analysing business failures (Politis & Gabrielsson, 2009). Consider, as an example, the famous Hawthorne studies where workers were asked to be part of an experiment; no matter how different independent variables were manipulated, worker productivity increased. For example, when the light in the factory was reduced, rest pauses were introduced, and group payment was changed to individual payment, still the production increased. The claim, now known as the Hawthorne effect, was that because the workers knew they were part of an experiment and being observed, their performance increased. An alternative explanation for the increased output is the feedback workers received.
regarding their performance. Parsons (1974), reviewed original data from the Hawthorne studies. He noted that the workers were provided with regular (half-hourly plus accumulated total) records of the work; this not only provided information about their performance relative to their targets, it also provided goal setting information that led to increased wages.

Irrespective of diverse theories and terminology, feedback has come to be regarded as a vital part in every individual’s development and learning progress. To experience feedback presents opportunity for an individual student to map progress toward his or her providence. Indeed, the commonly used definition of feedback, within behavioral science, is that it constitutes information allowing a learner to reduce the gap between what is evident currently and what could or should be the case (Sadler, 1989). Within educational programs, any feedback, so afforded, informs and guides an individual as to the next step to be undertaken. At least, that is the ideal.

**Feedback in the Classroom Context: Is There an Empathy Gap?**

Classroom-based research has disclosed three curious facets about feedback. First, teachers allege they dispense much helpful feedback to their students at relatively high levels and they claim they do so routinely. Second, trained classroom observers, in studies into interaction patterns in classrooms, disclosed that feedback occurred in most classrooms at relatively low levels, and barely at all in many locations. Even studies with highly expert teachers indicated strangely low levels of feedback observed during classroom instruction (Ingvarson & Hattie, 2008). Third, when students were asked what feedback they experienced in classrooms, many reported the level as being low to virtually nil. For instance, Nuthall (2007) tracked young children across extended periods and found they received considerably higher levels of feedback from their peers than their teachers (and most of the peer feedback was incorrect). For many students, feedback from teachers is indexed in terms of only several seconds per day.

In all this, there is the making of the classic empathy gap. The evaluation of a supposedly similar event depends upon who you are, the role or position you occupy, and the nature of the relationship within the interaction. Empathy gaps have been studied a good deal through social psychological research. For instance, we underestimate others’ pain when we have never had a similar experience (Nordgren, Banas, & MacDonald, 2011), and when we are in love it is difficult to understand what is like for one not to be. Our biases can lead to us to underestimate the influences of others’ experiences. The notion of empathy gaps between teachers and their students within the classroom, however, remains a matter yet to be fully explored. One area empathy gap has been examined is in relation to classroom management. For example, Lewis, Romi, and Roache (2012) found that students were inclined to blame teachers for punishments they received, even when teachers strove to be fair and just.

Teachers’ statements concerning feedback is that the their intentions are honest and open. They believe they are doing a sound job in this area and providing much feedback. For example, many excellent teachers realise that individual feedback is time consuming and will spend time instructing their class in how past assignments can be improved. However, in interviewing students, it is noted that group-level feedback is largely irrelevant to those that have mastered an objective, and often is ignored by those that have not. The teacher believes he or she has provided feedback, but many within the class are bored, tuned out, or simply focussing on other things in their life more important at the time. That students ‘tune out’ when teachers administer generic or group-level feedback is well known (Hattie & Gan, 2011).
A teacher may act as though he or she believes giving praise is a valuable form of feedback. Indeed, a low level of praise is welcomed and valuable in establishing relationships within a positive or benign classroom climate. Praise, however, quickly loses appeal, and is what classroom researchers call a threshold variable. You need to provide some praise, but not too much. If you praise a good deal, students learn you are a teacher that praises a good deal, and that is all. This is not a commodity you can increase and expect the effects of praise will increase. Psychologically, praise within the classroom can become problematic in that it fails to convey any genuine feedback information. Even worse, it can shift the students' attention onto irrelevant, even destructive, factors, such as excessive attention to the self or one's ability, thus discouraging further effort or listening to feedback about the task (Dweck, 1999; Skipper & Douglas, 2012).

**Recognising the Power of Feedback**

Several meta-analyses have established that the average effects attributable to feedback are among the highest we know in education, but also that feedback effects are among the most variable in their influences (Hattie & Timperley, 2007; Kluger & DeNisi, 1996; Shute, 2008). 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 ɑ = .79 (see Bertsch & Pesta, this volume, for a discussion of effect sizes and meta-analysis), which is twice the average effect (Hattie, 2009). This gives credence the common aphorisms that feedback can double the rate of learning, and that feedback is among the top 10 influences on achievement. It certainly is a common denominator of many of the top influences, and largely absent from those averaging below .40.

As highlighted in Kluger and DeNisi's (1996) review, the variance of feedback effects, however, is considerable, indicating that some types and circumstances of feedback are more powerful than others. It appears that merely prescribing high dosages of feedback does not imply that learning will take place, as one has to take into consideration differential effects on learners. It seems we know much about the power of feedback, but too little about how to harness this power and make it work more effectively in the classroom.

One of the hidden effects of feedback appears to be in influencing how much effort students allocate to an activity. In one controlled study, college students were asked to work on several tasks within a class period (Northcraft, Schmidt, & Ashford, 2011). It was found students devoted considerably more time and effort to those tasks upon which they discovered that specific and timely feedback was available. The availability and quality of feedback available to students can readily signal the importance placed on the learning activity by their teachers.

**Conceptions of Feedback and the Three Key Questions**

To appreciate feedback as a psychological process, it is helpful to draw attention to two rich models by way of analogy. These are (a) the computer video game, and (b) the motorist's GPS device. Computer games provide a player with immediate feedback on tasks, which provide individual challenges within a stimulating context. The machine monitors or ‘knows’ the player’s past history. This knowledge is used to ensure that the current problem is presented slightly beyond past accomplishment – that is using the Goldilocks principle – not too hard and not too easy. Feedback is then administered which, through applied effort, enables the prescribed challenge to be met. Such a process may continue for hours at a time.
In the case of your automobile’s GPS, travelling through an unknown city becomes a breeze. The device yields feedback information about where you are, and provides active directions and immediate feedback to guide you to a specified destination. The device assumes you know where you want to go, although you lack specific knowledge concerning how to get there. The GPS will not growl at you for deviations, but politely awaits your corrective action. If you fail to apprehend the supplied information, it is forgiving of any error you make, maintaining a patient unemotional disposition until you finally garner sufficient resources as to locate the desired pathway.

The computer game analogy is valuable in that it highlights the level of individual tailoring that has to take place and the critical importance of knowing where you currently are, having clear understanding of the criteria of success – and then much feedback is provided aimed to reduce this gap. The GPS analogy appears valuable in that it maps the key questions that underpin the successful applications of feedback in student-teacher interactions: The three key inevitable questions are always: (a) where is the student going? (b) Just how is the student getting on right now? (c) Just what is the next step?

**Where is the student going? The role of goals**

The first question fixes upon the role of clearly articulated goals. Feedback does not work in a vacuum. Instead, it registers discrepancy between the current state and a known objective. The student can be expected to be sensitive to experienced feedback only once there is a clearly known objective in place. This has to be seen as the necessary starting point.

There exists a substantial literature base concerning the value of goals and goal setting as base-level ingredients in motivation, effortful striving, and in achieving self-control (Locke & Latham, 2002; 2013). It has been shown that setting challenging goals is more motivating than either possessing easy goals or urging people to ‘do your best’. Available studies with adults suggest, however, this proposition is valid only when individuals are provided with feedback as to their progress towards the challenging goal. In the language of goal-setting theory, the presence of feedback moderates the impact of goal difficulty on personal striving. People work hard on difficult goals once they can perceive the availability of salient and supportive feedback. On the other hand, such feedback is unimportant if a goal is facile. When goals are easy, people do not depend on externally administered feedback, and providing such feedback adds no additional motivational value.

The critical goal underpinning effortful striving is not to appear ‘busy’, but to achieve a known and attainable standard or performance. Students need to be able to recognise successful products such that these products represent worthwhile goals attainable through personal effort. Although long-term goals are important, motivating goals require a short-term focus. When dealing with students, it is thus important for them to map a series of proximal sub goals as this helps considerably in maintaining effortful momentum. Teachers need to invest time ensuring that students are aware of immediate lesson goals and performance standards, and how these relate to the broader distal goals.

Hence, effective goals are expressed, not in terms of personal enjoyment or mere participation, but in terms of indexed outcomes, generally aligned within a sequence of ordered steps. Without such an understanding of the desired outcomes and the necessary sub goals, feedback could be disorienting, confusing, or interpreted as something about the student rather about than the current task that both parties (student and teacher) must focus upon.

Teachers profit immensely from being able to present motivating goals to students in terms of social modelling exemplars or worked examples. Students use such exposure to comprehend what success
looks like. These models can provide not only information as to what is the desired end state, but will also convey knowledge as to steps and processes undertaken on route. Indeed, the feedback process assumes that such sources of motivation and striving are firmly set into place as a base plan. Such motivation is shared by both teacher and student, and is often expressed, either explicitly or implicitly, in terms of a desirable modelling stimulus or completed product. To effect, there needs to be a definable entity to look at, value, dissect, and emulate. For example, providing worked examples of the goal is a major contributor to students putting in effort and being receptive to feedback (see Renkl, this volume for a discussion on worked-examples).

**What progress has been made? Or how am I going?**

The second pertinent question – *what is the level of progress?* - hinges upon at least one of the two agents (teacher or student) being in a position to assess the student’s strengths and weaknesses leading to the success criteria. For goals to be effective, students need information about current achievements. There is anticipated progress, and intermediate sub goals must be attained. Progress is generally along a prescribed track, which is not necessarily unique to the individual. There may be a necessary sequence or skills hierarchy to be mastered. An overall goal will imply a sequence of sub goals which may impose excessive load and make progress problematic. Feedback needs to take the form of realistic assessments as to how far along the journey the student has come, and can serve to reduce cognitive load by showing the students where in this sequence they need to exert their thinking and effort. Studies with high school students indicate that feedback becomes more effective when it reflects progress made in terms of actual accomplishments, rather than normative standards such as letter grades (Harks, Rakoczy, Hattie, Besser, & Klieme, 2013). Such process-oriented feedback is rated by students as more useful than grade information, and is linked to enhanced interest in the material being taught.

**What direction to take now? What is the next step?**

The third question *Where to next?* builds directly on answers elicited by the previous question. Students are disinterested in past errors and post-mortems, but clamour for guidance as to what to do in the future, as defined in terms of the next few minutes. The teacher’s role is now to enable resources, help, instruction, and scaffolds to be in place to assist the student to know *where to next?* A clear direction has to be identified. Through such guidance, progress toward the initial goal can be maintained with enthusiasm and effort. Students who receive feedback with little guidance as to how to approach the task to make revisions may feel frustrated, often leading to further negative affect (Lipnevich & Smith, 2009).

In connection with this third point, the GPS analogy becomes poignant. The device is programmed to only look forward. It remains unconcerned about any past streets, suburbs, or erstwhile errors passed through on route. Further, the same routes must apply to all individuals sharing the same goal. We may get to a location through using different roads and we make take longer or shorter to get there. But such differences are superficial since options are constrained severely by reality. At some point, all routes to one goal will converge, even though starting points vary. Despite the obvious gulf in technologies, we can see the GPS as providing a heuristic analogy as to how students can use teacher-sourced feedback in the classroom context. The analogy also suggests aspects of the process that teachers can find instructive, such as the need to move forward through non-emotional gestures. It also suggests that we may need to attend more closely to developing curricula progressions that model how students learn (whereas most curricula are based on how teachers would like students to progress).
Feedback Adapted to Student Needs: Responding to Levels of Mastery

It is well established in the literature that generic feedback in the form of teacher praise fails to encourage actual classroom learning in the manner suggested by earlier theories of self-esteem and of behavioural reinforcement (Brophy, 1981). Within the world of psychology, such theories were popular from the 1960s through to the present day. All-to-often, it was assumed that within the classroom then, (a) students needed high levels of affirmative feedback to bolster their self-esteem which then would have overall positive effects, and that (b) learners needed contingent positive reinforcement in the form of approval and praise, which would cement learned associations into place and enable mastery to be achieved. Unfortunately, both views were based on incomplete notions about human motivation, which in turn gave rise to insufficient conceptualizations about both (a) the feedback process itself, and (b) the role classroom teachers play in stimulating students' urge to learn and acquire knowledge.

Modern cognitive theories focus on learners' need to build their knowledge bases. Cognitive theory assumes that learning is goal-oriented, where comprehension and understanding are inevitable goals. Each student's fundamental problem is to understand his or her world, and to feel able to control, or at least make more predictable, key elements that impact directly on adjustment within that world. One of the basal problems facing each student sitting in a classroom is assessing what to learn, how much to learn, and how much – and where to expend effort. Biologically and psychologically, we are resource-limited creatures. Although educators thrive on messages such as 'learning for its own sake', or 'intrinsic motivation', the reality is that students arrive at school with the need to be cautious and economical in cognitive effort expenditure (Willingham, 2009).

As stressed earlier, the feedback process moderates the impact of perceived goal difficulty. Difficult goals motivate striving once a learner can see that efforts will be acknowledged. If the goal is difficult, long term, or remote, then students need instruction, scaffolding, and feedback to operate in a seamless process as they continue to invest effort and attention to meet the goal. We suggest that that learners' needs surface in three distinct guises as related to level of knowledge and expertise. These three levels are: (a) initial knowledge acquisition, with a focus on building knowledge in new areas, (b) applying knowledge and skills acquired earlier, and (c) exhibiting strong levels of mastery or expertise. Below is a brief review of what is known about the effective feedback process in relation to these levels.

Initial knowledge acquisition

Beginners need feedback based on content knowledge while striving to build basic knowledge and vocabulary. They need assurance and corrective feedback, often in the form of discriminations such as correct versus incorrect, or right versus wrong. They need to know they are heading in the right direction, and that they are using the right vocabulary within the right context. They will appreciate also a level of encouragement in confidence building. They require teachers' recognition that they are genuinely getting somewhere along the path to greater understanding. Their mental efforts will involve a good deal of memory load, which can be a huge source of stress. Of major importance to beginners is (a) the feeling that they have been able to recall a relatively complete set of knowledge elements, and (b) that they will not be caught out displaying glaring omissions relative to what is known by other people.
**Applying knowledge**

Intermediate learners have acquired basic concepts but need help linking ideas together, seeing relationships, and in extending and elaborating upon the basic ideas. They need assurance that they are applying the right methods and strategies in the right place. Since they are starting to move beyond the information given, they need to know if the inferences they have been making are seen as valid ones by a more knowledgeable or senior agent such as a teacher. They appreciate positively phrased suggestions for alternative strategies (For instance, “strong use of adjectives in just the right spots”, “good use of the acceleration principle, but other principles could play a role here”, or “a beautifully well-constructed argument, but have you thought of what this implies for the future?”).

At this stage, there is less stress on straight memory recall, but a marked shift into describing relationships between interacting elements, and knowing valid procedures to apply. These students lap up worked examples, which demonstrate how basic materials, as previously mastered, will provide powerful means of understanding broader areas of functioning. The student needs to appreciate that knowledge elements do not reside as isolated islands of limited or useless facts. Instead, knowledge is vital and is implicated in much broader pictures. Hence, the role of feedback is now one of assuring the student that, when expressed in conceptual, schematic, and procedural forms, then securely acquired knowledge is being applied well beyond the time and place of the original learning.

**Advanced mastery level**

At more advanced levels, helpful feedback takes the form of supporting the self-regulated learner such that sincere efforts to extend and apply knowledge even further are actively recognised. The recognition here is that the outcome or product achieved is of such quality as to approach the highest level of achievement possible. Hence, the teacher takes time to acknowledge both the effort expended and the product achieved. In essence, different types of feedback work best depending on the individual’s phase of learning -- corrective feedback is suited for novices, process feedback is needed as the learner develops proficiency, and elaborated conceptual feedback becomes appropriate with highly competent students. One of the outcomes from this level is more automaticity in what has been learned, which is powerful when starting on the next series of knowledge building, and so on. This is a virtuous cycle as it makes the next series somewhat more fluid, whereas those who do not advance much past the first level are bound to be more cognitive resource intensive and this can revert into a less virtuous cycle leading to giving up, reducing effort, and seeking easier goals.

**The Learner’s Need to Self-Correct: How Does Delay in Feedback Play a Facilitating Role?**

Beginning learners profit from feedback close in time to their responses – particularly during the initial knowledge acquisition phase. Indeed, the traditional finding in this area has been that with any simple learning, or with fine-grain discriminations, or in motor sports areas, then effective feedback takes place immediately, sometimes within seconds. Immediate feedback assists the initial knowledge or skill acquisition process when dealing with novices; with increasing skill level, immediately applied feedback is less critical. Once the products of effort become more visible, then the key element is for recognition of the quality and value of those outcomes. Such an aspect has been referred to as the IKEA effect (Hattie & Yates, 2014). Students value what they produce and will expect you to recognise the inherent value of their work, and possibly devalue if you fail to do this (Norton, Mochon, & Ariely, 2012).
Once learners become knowledgeable and relatively autonomous, then immediate feedback becomes less critical. Immediately experienced feedback can even discourage the emerging self-correction process (Mathan & Koedinger, 2005). As mastery is acquired, students develop strategies for monitoring, review, and revision. Since it takes time for reflection, and to access and apply one’s knowledge base, it can be unhelpful to receive gratuitous feedback too early in the piece.

In essence, poorly timed external feedback may subtract from the opportunity to engage in self-corrective personal feedback. This aspect becomes more pertinent when feedback is targeted upon lower level activities that fail to relate well to more advanced product-oriented goals harboured within the recipient’s mind. Furthermore, several studies indicate that when people are exposed to continuous monitoring, even when applied by the self, then on-going performances in complex situations can be disrupted (Shapira, Gundar-Goshen, Liberman, & Dar, 2013). A modicum of monitoring is helpful, but too much becomes destructive.

It is important for the person administering feedback to recognise the unit of work being produced by an individual, and the mental processes and demands so involved. Recognition of the individual’s cognitive load and the value being placed on the resultant outcomes, become key elements underpinning feedback effects when dealing with clever and knowledgeable individuals. One of the purposes of feedback is to provide information or strategies to reduce cognitive load such that the student expends thinking power onto specific aspects of the task that they are working on. On the other hand, aspects such as timing become less important at this level.

Evidence from laboratory studies indicates that, when learning clearly does take place, immediate feedback may be unnecessary, but feedback, when delayed, can still contribute to learning through a beneficial spacing effect. That is, a delay of several hours, or even a day, between the initial acquisition of complex information, and receiving feedback (for instance on a test) may serve to provide valuable practice in retrieval and use of the initial learning (Metcalfe, Kornell, & Finn, 2009; Roediger & Butler, 2011).

It defies common sense to think that learning is enhanced when feedback is deliberately withheld. But that reality becomes possible provided learning is secure in the first place, and when immediately applied feedback serves little purpose. Such a notion cannot be applied easily in classrooms. Teachers cannot control all the factors that account for learning in the way a laboratory study might operate. It would be churlish to withhold feedback on this rationale. In general, teachers have to operate on the heuristic that feedback is best applied soon after a task is completed to the learner’s satisfaction. On the other hand, it is comforting to know that when a teacher does give delayed feedback on tests, it may assist students through active retrieval practice.

**The Issue of Positive and Negative**

The impact of negative experience considerably outweighs positive experience. This notion is captured by the phrase 'bad is stronger than good', which sums up a considerable body of research (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). On the other hand, many classroom 'process-product' studies conducted in the 1970s repeatedly found high levels of teacher criticism to have a negative impact on many classroom indices, including student achievement test scores (Brophy, 1981, 1986). Punitive teachers contribute to negative classroom climate, which is linked with a range of undesirable outcomes, often in a manner suggesting snowball or cascade effects (Demanet & Van Houtte, 2012).
Such findings, however, cannot be interpreted to mean that feedback needs to be set at some universally positive level. Indeed, the findings cited in the previous paragraph most often refer to instances where teacher criticism was associated with student conduct matters. When it comes to receiving feedback for goal directed efforts, however, its purpose is to indicate deficiencies, to correct for errors, or to suggest better ways of proceeding. This type of feedback is ‘negative’ only in the sense that its purpose is to redirect effort in a different direction (i.e., akin to the customary meaning of the term negative feedback as used in engineering systems).

Corrective feedback can be carried out within the context of positive teacher-student relationships, especially when the teacher displays a positive and respectful attitude toward student efforts, and communicates that such errors are natural steps along the path to mastery. Such positive relationships (not only between teacher and student, but among students) is often a precursor to building the trust needed to not merely tolerate, but welcome feedback that is specific and understood. The notion that excellent teachers express expectations in accord with incremental learning approaches, rather than treat fumbling efforts as indexing fixed ability, has been well documented under the rubric of teacher expectancy effects (Cooper, Hinkel, & Good, 1980; Rattan, Good, & Dweck, 2012; Rubie-Davies, 2007).

When teachers dispense feedback in the sense of disconfirmation and error correction, the critical facet will lie in the student's perception of the teacher's purpose, and not in terms of any constant need for positive affirmation. As indicated earlier, the impact of feedback is bound up with recipients' understandings of the nature of the objectives and respective goals being pursued by all parties. In a study with 11-year old students, Autin and Cloizet (2012) showed that the effects of failure on a difficult problem solving task were offset by conveying to students the idea that experiencing difficulty is a perfectly normal and expected part of the learning process (see also Clark & Bjork, this volume for a discussion on desirable difficulties and errorful learning). Students who heard this explicit message before failing performed better on a subsequent series of memory and comprehension tasks, than those who had not heard the message, and also better than a third group that had experienced only success on easy problem solving tasks beforehand. Being able to “wallow in the pit” of problem solving is learned skill, often needing high levels of feedback (but not necessarily immediately).

A child's tendency to attribute lack of immediate success to personal capability rather than to natural task difficulty is one central aspect of the learned helplessness syndrome (Au, Watkins, & Hattie, 2010; Diener & Dweck, 1978). However, the average child possesses sufficient resilience to avoid functioning in self-defeating ways, and steadfastly avoids such premature attributions. Nevertheless, it is worth noting that helplessness symptoms have been shown to be elicited in students when teachers are consistently paired with students’ failure experiences (Dweck & Reppucci, 1973), or when teachers convey the notion that failure on tests is an acceptable outcome, even one worthy of sympathy (Graham, 1984).

Once students are aware that they have some distance to travel, then 'errors' are no longer perceived as negative. Errors are tentative trials rather than the endgame. They can represent significant efforts, achieved with some cost, which have some resemblance to a product. But such efforts do not represent or account for the final version. What may be rated as 'negative' by a casual observer may be 'positive' to a learner. This becomes pertinent when a student is aware that substantive goal progress is being made and is being acknowledged by a teacher appreciative of both (a) the approximations attained, and (b) the genuine level of psychological load and effort experienced by the student at the moment of production.
Appreciating When Feedback Is, and Is Not, a Critical Component of Classroom Learning

Feedback is not an isolated or unitary process. Instead it is embedded within a sequence of instructional moves that enable a teacher to convey to a student that specific outcomes are attainable. Teachers naturally employ motivational strategies, convey aspirations, create desires, and outline new possible selves. But remote goals are vacuous in the absence of explicit scaffolding, direct instruction, modelling stimuli, and appropriate feedback. Certainly, students view those teachers who provide feedback as more committed to their progress (Lipnevich & Smith, 2009).

Feedback becomes a key determinant of classroom-based learning when tasks are difficult, the student lacks knowledge, and unassisted efforts toward a remote goal will occasion likely disappointment. Many aspects of classroom life and behaviour may not require any explicit feedback on the part of a teacher. Once an individual has acquired a skill, its maintenance requires little external support. However, students arrive at school deficient in their knowledge of areas such as science, geography, social history, and mathematics. Developing mastery in such curriculum areas will require the teacher to manage learning sequences with sensitivity and precision.

For many students, school learning is hard, mentally demanding, and potentially energy sapping. At the individual level, the problem is to perceive a knowledge chasm as a knowledge gap to be bridged. Such a view is aided by two other necessary perceptions: (a) that one’s achievement is not limited by inherently fixed attributes such as intelligence, and (b) outcome is correlated with effort. If such incremental beliefs are to supplant an entity view of personal capacity, then supportive instructional components need to be in place. This is the essential classroom context within which teachers’ use of the feedback principle will determine how their students’ will elect to deploy their limited energies.

The Place of Error

Feedback thrives on errors, but for many educators errors have been something they tend to minimise, and students too often see errors as indicators of their failure to material. Indeed, Skinner (1953), the father of behaviourism, equated errors with punishment that inhibits behaviour. Since this time, many researchers have tried to classify errors. Reason (1990) saw errors as part of three cognitive stages. The first stage relates to the formation of an intention and planning of the subsequent actions, and an error relates to an incorrect intention—such that while the action proceeds the intention may be inappropriate. The second stage involves the storage and retention of task-salient information, such that an error is a ‘lapse’ usually related to retaining information appropriate for the task. The third stage consists of executing the specified action, and an error, or ‘slip’ refers to the incorrect implementation of a correctly formulated intention and plan. Hence, feedback can be oriented to each of these stages, perhaps by assisting the student to be aware of the intention or success criteria, by ensuring that the progression through the actions to the intention are well scripted (e.g., by providing a rubric), that there are many opportunities to pick up ‘lapses’ and relearn or learn anew task salient information, or to provide students the answers so they can concentrate on the process of getting to the answers.

By considering an environment where errors are welcomed, feedback can be more effective. From this error-perspective, feedback can be considered as ‘disruptive’ in that its role is to move the student back onto the path of moving to the intention or success criteria. Of course, it helps if the student is adept at error-detection, but often this is the primary skill needed in learning (and for feedback to be sought and received).
With adult participants, there has been recent research on error management training. Such training is based on three premises: there is only minimal guidance and students are encouraged to actively explore and experiment with the concepts being learning; students are told to expect errors and that they should be considered positive to learning; and when encountering errors, students are encouraged to think ahead and try something new. Keith and Frese (2008) completed a meta-analysis of 24 studies that compared error management training with an alternative training. The overall effect was .44 which led them to conclude that EMT leads to better training outcomes compared with training methods that do not encourage errors during training. The effects were higher when the major training goal is to transfer learned skills to novel problems (adaptive transfer, $d = .80$) than where the goal is to learning and apply just one particular procedures (analogical transfer, $d = .20$).

**In Perspective: When Feedback is Effective**

As stressed earlier, feedback is not an isolated classroom procedure. Its impact depends on adequacy of the instructions the teacher has conveyed, the nature of the goals and sub goals set, and the students’ conception of the assessment to be applied. To complete this chapter we list nine key points that help to describe when feedback becomes an effective instructional component.

1. The feedback process resides in that what is received and interpreted by a student, rather than what a teacher gives or believes has taken place.
2. Feedback can work best when criteria for success are known to the learner in advance, and where the goal to achieve such success is shared by students and teacher alike.
3. Feedback can best cue attention onto a task, with a known goal or sub goal, and away from self-focus.
4. Feedback must engage a learner at, or just above, the current level of functioning.
5. Feedback must challenge the student to invest effort in moving forwards, and assure the learner that it is perfectly natural to experience difficulties when mastering difficult tasks.
6. Feedback is powerful when the classroom climate is one of welcoming errors and seeing disconfirmation as a natural and positive part of developing and exercising new skills.
7. It is optimal when feedback matches the content of the instruction given earlier, and is in accord with available social modelling stimuli identified as worthy of emulation.
8. Feedback thrives in an environment where errors are welcomed, and error training may be a worthwhile adjunct to increase the power of feedback.
9. Feedback is received and used by students when teachers themselves are prepared to adapt and adjust their methods and priorities in response to the outcomes indexed through their students' success on various assessment outcomes.

**References**


