But what do we mean by efficacy?
Efficacy is not the same as effectiveness or efficiency, although both are part of efficacy. At Pearson, what we mean by efficacy is making sure that we have a measurable impact on improving someone’s life through learning. We want everything we do to be focused on learners and to know that all of our products and services are making a difference.

How do we determine that we are making a measurable difference?
Only a longitudinal study over a few years will come up with a definitive answer to this; however, we can take steps in the development phase of our products and services to ensure there is a strong evidence base supporting their design. This ranges from reviewing academic research, involvement with universities, testing features and function with students and teachers, as well as an on-going review of the data being collected and how the product is being used.

One example of the way that efficacy is being implemented is Pearson Lightbook, a new digital product being developed for senior Secondary students. A major element of Pearson Lightbook is the ability to continuously track student performance in ways that were impossible with traditional teaching and learning resources.

Using efficacy to design Pearson Lightbook
As a starting point, we began with the work of Professor John Hattie from the University of Melbourne to establish features we could use that would have the biggest impact on student learning. Hattie looked at the effect sizes of 900-plus meta-analyses of the influence of programs, policies, innovations related to student achievement.

<table>
<thead>
<tr>
<th>INFLUENCE</th>
<th>EFFECT SIZE</th>
<th>INFLUENCE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Providing formative evaluation</td>
<td>0.90</td>
<td>Worked examples</td>
<td>0.57</td>
</tr>
<tr>
<td>Feedback</td>
<td>0.75</td>
<td>Goals</td>
<td>0.50</td>
</tr>
<tr>
<td>Spaced Vs massed practice</td>
<td>0.71</td>
<td>Motivation</td>
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<td>Meta-cognitive strategies</td>
<td>0.69</td>
<td>Advance organisers</td>
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<td>Student prior achievement</td>
<td>0.67</td>
<td>Simulation and games</td>
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</tr>
<tr>
<td>Acceleration</td>
<td>0.69</td>
<td>Computer-assisted instruction</td>
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</tr>
<tr>
<td>Self-verbalization and questioning</td>
<td>0.65</td>
<td>Teaching test taking and coaching</td>
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</tr>
<tr>
<td>Study skills</td>
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<td>Instructional media</td>
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<tr>
<td>Teaching strategies</td>
<td>0.62</td>
<td>Affective attributes of students</td>
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<tr>
<td>Problem solving teaching</td>
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<td>Physical attributes of students</td>
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<tr>
<td>Mastery learning</td>
<td>0.58</td>
<td>Audio-visual aids</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Table 1 – Effect Sizes (Hattie, 2012b). Effect sizes shown in bold are those that have been prioritized for Pearson Lightbook.
A key finding was almost everything works – ninety per cent of initiatives implemented have a positive effect. The average effect size of students moving from one year to the next was found to be 0.40. So the next question is, if on average a student will move 0.40 without a specific focus in place, what elements can we influence and address that we know will have an even greater effect (Hattie, 2012a)?

Looking at these effect sizes and what we can influence, we have integrated the following features into our research-informed design.

Each of these features been demonstrated to have a positive effect on student learning. By studying the research on these features we have determined how we can best use technology to utilise and integrate them to bring the maximum benefit to the learner and their teachers.

**Providing formative evaluation (effect size 0.90)**

**What is formative evaluation/assessment?**

*Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited.* (Black & Wiliam, 2009)

*Assessment for the purposes of improving teaching and learning is what is called “formative assessment”.* (Hill, 2013)

*Assessment carried out during the instructional process for the purpose of improving teaching or learning.* (Bransford & Darling-Hammond, 2005)

Dylan Wiliam proposes formative assessment as a process of capitalising on “moments of contingency” for the purpose of regulating learning processes. He proposes that it is the key to improving the quality of teaching and entails five strategies:

1. Clarifying, sharing and understanding learning intentions and criteria for success
2. Engineering classroom activities that elicit evidence of learning
3. Providing feedback that moves learners forward
4. Activating students as instructional resources for one another
5. Activating students as owners of their own learning

(Wiliam, 2010)

**Pearson Lightbook** has embedded formative assessment throughout the course, enabling both learners and teachers to establish at any time where they are in their learning. The progress tracker allows students to easily see their level of understanding compared to the level they need to reach, allowing both students and teachers to then establish what they need to do to get there. Our progress tracker serves the following purposes:

1. It provides teachers with a picture (using data and graphs) about who they taught well, what they taught well, strengths and weaknesses, as well as the opportunity to modify and enhance what they are doing.
2. It also provides students with a picture about what they know, what they still need to learn and how to begin working out with their teacher what they need to get there.

There are three types of progress reports that can be used in different stages of the learning process:

1. **Summary reports**
   - Progress by chapter
   - Summative assessments
   - Practice exams
2. **Progress by feature:**
   - Before you begin
   - Active exercises/checkpoints
3. **On the page reports**
   - Before you begin
   - Question sets
Feedback – effect size 0.75

Formative assessment does make a difference but depends very much on the type and quality of feedback given (D. R. Sadler, 1998) (Hattie & Timperley, 2007).

Feedback can be given in the following ways:
• Direct personal feedback interaction between a teacher and student or between students
• Right/wrong
• Correct answer
• Repeat until correct
• Explanation of correct and incorrect answers
• Providing cues, hints.
  (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991)

To have an instructional purpose, feedback needs to provide information specifically relating to the task or process of learning that fills a gap between what is understood and what is aimed to be understood (R. Sadler, 1989).

Timing of feedback is also important and its effect depends on purpose and phase of learning. It can be:
• Immediately after each response
• Immediately after an entire test is completed or
• After a delay of a day or more.

Feedback that informs students of correct answers after they have formulated their own response has the most positive effect. It is important that students have engaged with the question and have the chance to respond or are given a scaffolded cue before being provided with the correct response. When students are informed of the correct answer with relatively little prompting, it greatly improves their ability to retrieve information later on.

A considerable variety of feedback types are being incorporated into Pearson Lightbook, depending on the context and phase of learning. In addition, all questions/question sets will provide both student and teachers to write or record a comment. Feedback outside assessment is also provided to teachers from students, and from teachers to students, and is equally important. Opportunities for students to tell teachers what they already know prior to instruction is invaluable information for a teacher. It is also important in helping students become responsible for their own learning and start to own that process. Pearson Lightbook will allow a before and after opportunity for students to rate their level of understanding of a topic is provided and enable self-reflection on how they had progressed, what worked well, what methods they used to progress and what can they do to make further progress.

Worked examples (effect size 0.57)

A worked example is an alternative instructional model that best suits highly structured subjects such as Maths and Physics and has been shown to offer the most benefit for those students who have little or no prior knowledge or understanding (Crissman, 2006). Crissman’s work established that the design of a worked example influenced the size of the benefit and that a faded solution method produced the greatest effect. This instructional model of fading solution steps proposes a smooth transition from complete worked-examples to independent problem-solving in which instructional support fades during the transition. A worked example has been shown to reduce cognitive load though directing attention appropriately when compared to problem solving methods in highly structured subjects, particularly in skill acquisition (Sweller, 1990).

This feature is used in Pearson Lightbook throughout Maths and Physics, with structured “Worked Examples” and faded solution steps in “Try Yourself”
Spaced vs massed practice (effect size 0.71)

Spaced practice is where students have exposure to practise something over several days as opposed to practising a task continuously without a rest in between (Donovan & Radosevich, 1999). Donovan and Radosevich also found from their meta-analysis of 63 studies, that spaced practice had a significant effect on both acquisition and retention of the learning. Hattie suggests that this also needs to be deliberative practice and not just drill and practise (Hattie, 2012a, p.185).

Pearson Lightbook has maximised the opportunity for acquisition and retention through multiple opportunities to practice throughout the topic and, in Maths, by offering a range and number of question sets.

The research that has gone into Pearson Lightbook is really just the beginning. As we embark on this journey with schools to launch it, as a new type of product based on the web, we will be able to use our Efficacy Framework to interpret how students and teachers are interacting with it. Here lies the real power of Efficacy - to be able to see the effect of the product when it is used in schools and at home, by teachers and students, and to continue to improve it.

References


