

Information sheet

Active learning. Some underlying principles

(i) Build on the knowledge learners bring to sessions

Effective teaching assumes that learners do not arrive at sessions as 'blank slates', but as actively thinking people with a wide variety of skills and conceptions. Research shows that teaching is more effective when it assesses and uses prior learning to adapt to the needs of learners [1]. This prior learning may be uncovered through any activity that offers learners opportunities to express their understanding. It does not require more testing. For example, it can take the form of a single written question given at the beginning of a session to set the agenda for that session and elicit a range of explanations. These responses may then be used as a starting point for discussion.

(ii) Expose and discuss common misconceptions

Research has shown that teaching becomes more effective when common mistakes and misconceptions are systematically exposed, challenged and discussed [2]. Cognitive conflicts occur when the learner recognises inconsistencies between existing beliefs and observed events. This happens, for example, when a learner completes a task using more than one method and arrives at conflicting answers. Activities are carefully designed so that such conflicts are likely to occur. Research has shown that such conflicts, when resolved through reflective discussion, lead to more permanent learning than conventional, incremental teaching methods, which seek to avoid learners making 'mistakes'.

(iii) Develop effective questioning

There have been many studies of teachers' questioning. Typically, most questions are low-level, testing the ability of learners to recall facts and procedures. Such questions are also called 'closed', meaning that they permit just one single correct response. Fewer questions promote higher-level reflective thinking, such as the ability to apply, synthesise or explain. Such questions are called 'open' because they invite a range of responses. The research evidence shows that a variety of lower-level and higher-level open questions is much more beneficial than a continuous diet of closed recall questions.

A second finding is the importance of allowing time for learners to think before offering help or moving on to ask a second learner. Studies have shown that many teachers wait for less than one second. Longer 'wait times' are associated with significantly improved achievement [2].

(iv) Use co-operative small group work

Many learners think that learning is a private activity. They frequently enter post-16 education under-confident and reluctant to discuss difficulties. It is therefore essential that a supportive and encouraging atmosphere is created in the learning environment. It is the teacher's responsibility to ensure that everyone feels able to participate in discussions and this is often easier in small group situations.

There is now general agreement in research that cooperative small group work has positive effects on learning, but that this is dependent on the existence of shared goals for the group and individual accountability for the attainment of these goals. It has also been seen to have a positive effect on social skills and self-esteem [2].

(v) Emphasise methods rather than answers

Often we find that learners focus more on obtaining a correct answer than on learning a powerful method. They often see their task as 'getting through' an exercise rather than working on an idea. Completion is seen as more important than comprehension. In these resources, we do not concern ourselves with whether or not learners complete every task, but instead we try to increase their power to explain and use mathematical ideas. Learners may work on fewer problems than in conventional texts, but they come to understand them more deeply as they tackle them using more than one method.

(vi) Use rich collaborative tasks

Rich tasks:

- are accessible and extendable;
- allow learners to make decisions;
- involve learners in testing, proving, explaining, reflecting, interpreting;
- promote discussion and communication;
- encourage originality and invention;
- encourage 'what if?' and 'what if not?' questions;
- are enjoyable and contain the opportunity for surprise. [3]

Textbooks often assume that we should begin topics by solving simple questions and then gradually move towards more complex questions. While this may appear natural, we find that learners tend to solve simple questions by intuitive methods that do not generalise to more complex problems. When the teacher insists that they use more generalisable methods, learners do not understand why they should do so when intuitive methods work so well. Simple tasks do not motivate a **need** to learn.

Rich tasks also allow **all** learners to find something challenging and at an appropriate level to work on.

1. Black P., Williams D., and The Assessment Reform Group, *Assessment for learning: beyond the black box*, Cambridge, 1999, University of Cambridge School of Education.
2. Askew M., and William D., 'Recent research in mathematics education 5-16, *Ofsted Reviews of Research*, vol.53, London, 1995, HMSO, 2005,
3. Ahmed A., *Better mathematics: a curriculum development study*, London (1987): HMSO 104