

The perceived success of interventions in science education: a summary

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by

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1. Introduction

Over many years much effort and funding has gone into developing interventions to improve standards in education. Although the majority of interventions lack high quality evidence about their effectiveness, stakeholders - including policy makers, researchers, teachers and subject communities – still make judgements about their levels of success. Critically, decisions are being made throughout the system about which interventions to adopt, promote, fund, continue or stop. This raises the question: in the absence of robust evidence, on what grounds are interventions considered to be successful or not?

The purpose of this study was to explore, with specific reference to science education, what a range of stakeholders consider to be the features of successful interventions. The findings should be considered not only in the context of developments related to science and other STEM (science, technology, engineering and maths) subjects but also against the background of the wider changes in education policy that have taken, and are taking, place in England.

The increasing pressures on funding and accountability highlight the importance of making good decisions on which interventions to adopt or reject and how to improve the likelihood of an intervention being successful. This in turn emphasises the need for better understanding of the grounds on which interventions are considered to be successful and, importantly, what the elements are that contribute to making an intervention judged to be successful in practice.

2. Methodology

This was designed as a qualitative study to explore four guiding questions:

- Which interventions to improve the quality of teaching and learning in science education are considered to be (or have been) successful by a range of stakeholders and why?
- What are the factors that are considered to contribute to the levels of success of interventions to improve the quality of teaching and learning in science?
- To what extent do the perceptions of stakeholders reflect the available evidence as to the levels of success of interventions?
- In what ways might the effectiveness and impact of interventions be improved in order to establish sustained improvements in science education?

The study adopted an iterative approach which involved a search of existing literature, semi-structured interviews with a total of 30 individuals from range of backgrounds and focus groups with 15 teachers.

3. Existing literature

The education research literature contains many reports of studies which have examined the effects of interventions intended to improve teaching and learning. Despite the range of material, there is very little analysis of what makes some interventions successful and others less so. A fully comprehensive review of the literature was beyond the scope of the current study but exploration of key exemplars identified three elements as contributing to successful interventions:

- underpinning principles to provide clarity and purpose behind the intervention regardless of whether it related to system-wide change or learning of individual students
- the expertise of the personnel
- the context for the intervention, including culture and history.

4. Defining terms: success and intervention

Participants in the study emphasised that judging the level of success of any activity involves considering a number of factors. They felt that judgements about interventions will be influenced by the personalities involved and depend upon the level of detail at which the judgement is made, the criteria against which the intervention is being assessed and the time that has elapsed since its introduction. More specifically they considered success in terms of how they perceived an intervention had met its objectives, the effect it had on its audience, its underlying principles, its wider influence,

return on investment, the type and quality of evidence available, and the complexity of the problem it was intended to address.

The term 'intervention' was considered to cover a range of activities often referred to as 'initiatives' (mostly to refer to policy developments), 'programmes' or 'projects' (terms used interchangeably for activities of differing size and timescale) and 'interventions' (used very specifically for pedagogical approaches to bring about a change in learning). A core purpose of interventions was seen as bringing about change; how well they did that was a mark of their success.

5. Perceptions of the example interventions

Overall interviewees were positive about interventions in science education, acknowledging that there were very few in their experience that had nothing to offer to improve young people's experiences. None of the interventions described as successful, however, were seen to be without shortcomings or limitations. Particular concerns were expressed about unintended consequences that resulted when interventions become implemented in a way that was at odds with the original purpose.

The interventions identified during the study could be placed into five groups according to their underlying stimulus, but the boundaries of these groups are not rigid, nor are any of the interventions restricted to any one of the following areas:

- **Policy-driven interventions** endeavour to create an environment in which new approaches can be introduced and successfully implemented to bring about the change required to meet the identified needs and/or the strategic goals.
- **Knowledge-building** interventions develop new understandings and thinking about ways of improving thinking and learning, and provide evidence of the effectiveness of interventions that, in turn, generate further knowledge and inform new thinking and understanding.
- **Pedagogical improvement**, based on sound principles, provides teaching and learning strategies and techniques that are used to engage students in learning to improve their skills, knowledge and conceptual understanding, both generally and in specific disciplines.
- **Curriculum developments** explore ways in which particular skills (academic, practical and interpersonal), knowledge and conceptual understanding can be provided for students in contexts which help generate interest in, and enthusiasm for, learning in general and of specific subjects.
- **Enhancement and enrichment activities** provide a large variety of opportunities to young people that broaden their experiences of science and help contextualise the curriculum.

Consideration of these groups underlined how the perception of interventions varied and how the criteria for success differed according to the perceived purpose of the interventions in question.

6. Judging success

Throughout the study, participants reiterated that no two interventions are alike nor do they follow the same pattern of development or impact. Thus, applying exactly the same criteria to every intervention regardless of its size, scope and stage of development is considered unhelpful. Without exception, participants pointed out that their responses and observations were greatly influenced by their current roles, experience and personal philosophy towards education in general and science education in particular. Despite this, there was a considerable degree of consensus around the criteria that might be used to judge success; these fall into the six categories shown in Table 1.

The majority of interviewees also referred to evaluation as a way of trying to determine how successful an intervention was, but major concerns were expressed about the limitations of many such exercises.

Despite the emphasis placed on the need for robust research and good evidence to develop successful interventions, the perception is that in practice little use is made of either existing evidence

or that which is gathered during an intervention itself. Specific concerns were expressed about teachers' lack of engagement with research. Although many teachers involve themselves in some form of action research, many resist using evidence when they feel it does not fit with their own experience. On a more positive note, the increased focus in recent years on evidence-based practice and policy was acknowledged as a step in the right direction but there are still many questions to be addressed, including the use of randomised controlled trials, the matching of large- and small-scale practice, and greater understanding of the processes required for developing successful and effective interventions.

Table 1: Criteria of success for interventions

Category	Examples of specific criteria
A. Levels of take up	Number of schools involved or adopting the intervention
	Number of teachers using the intervention
	Number of pupils reached by the intervention
B. Improvement in attainment	Changes in examination results
	Number and level of qualifications achieved
	In-school test results
	Increases in competence levels
C. Engagement of pupils	Level of uptake post-16
	Leaving destinations e.g. pupils going into STEM careers
	Participation in out-of-school activities
	Attitude surveys of interest in science
	Teacher observations of pupil behaviour
D. Changes in practice	Quality of interaction between learner and teacher
	Levels of inquiry-based learning
	Ease and consistency in implementing the intervention
	Extent to which changes become embedded in practice
E. Changing terms of the debate	Degree of influence on policy
	Impact on practice
	Adoption of the principles of the intervention by others
	Effect on wider behaviours of schools and teachers
F. Value for money	Cost–benefit analysis of the intervention

7. Developing successful interventions

Throughout the interviews and focus groups there was a unanimous view that no silver bullet will ensure the success of an intervention. There was, however, a consensus that successful interventions depended on a combination of key elements, which included:

- a clear definition of the purpose of and need for the intervention
- the clarity of the process
- the effectiveness of the implementation
- the suitability of the people involved
- the appropriate level of monitoring, evidence and accountability
- the quality of communication, promotion and profile it achieves.

Even if all the other elements are in place, there remains a degree of chance that some interventions appear to “catch the tide” and the “mood of the time” in relation to the political environment or the appetite for change within the education community. Other factors which in the right circumstances

might contribute to success are more often perceived to be barriers: system issues at the national level (expressed as too many initiatives and pressures of accountability); system issues at the school level (not enough time to think outside the day-to-day activity); and the positions people adopt (mainly referred to as senior management blocking initiatives).

8. Towards a framework for successful interventions

There is no black-and-white distinction between what is perceived to be a successful or unsuccessful intervention because, ultimately, it is a judgement based on a combination of factors. This study attempted to gain some insights as to how a range of individuals perceive interventions to be successful or otherwise. Reflection on the views expressed identifies seven cross-cutting issues, leading to nine recommendations.

The clarity of purpose and shared understanding of a successful intervention

It is felt that many interventions are based on a good idea but their objectives are not well thought through and are rarely challenged in order to determine whether or not this is the right thing to do and the right way to do it.

***Recommendation 1:** Initiators, developers and other stakeholders should ensure that interventions have a clear purpose meeting well-defined needs to address and overcome a problem which is well-evidenced and articulated.*

***Recommendation 2:** Despite the progress that has been made in recent years, greater efforts are still required by all parties to bridge the communication gap between teachers and originators of interventions both big and small.*

The quality, quantity and nature of evidence used to define and judge success

The evidence base for the effectiveness of individual interventions is not, in general, very strong, despite the fact there is almost universal acceptance that robust and valid evidence is critical in deciding the success of an intervention.

***Recommendation 3:** All parties involved in interventions should give a higher priority to the use of existing evidence to inform the design of interventions and to the collection and use of evidence as an integral part of the intervention. There should be: clearer reasons for gathering evidence; a better match between the type of evidence collected and the questions that are being addressed; and a strengthening of the processes for monitoring progress and impact of the intervention, including unexpected outcomes.*

***Recommendation 4:** Further efforts are needed to improve the evaluation of interventions in order to strengthen the contribution it can make to the outputs and outcomes of interventions. This could involve improved guidelines from funders, training for practitioners involved in interventions, and reviews of families of evaluations to consolidate findings on the effectiveness of the interventions and on the process of the evaluation itself.*

The degree to which the situational context affects the likely success of an intervention

There is a strong view that the situational context into which an intervention is introduced influences the likelihood of its success but there appears to be little understanding of the extent to which interventions have to be tailored to specific contexts or groups of pupils or the extent to which they can be modified before they cease to be effective.

***Recommendation 5:** Further consideration needs to be given to:*

- *additional research to understand better how interventions can be applied effectively to new contexts*
- *greater emphasis on support and training for implementing the intervention when it is introduced into a new context.*

The extent to which the impact of policy changes might hamper or support the initiation and development of successful interventions

The policy environment is considered to have had an increasingly strong influence on the number and nature of interventions all competing for attention one way or another. Science, and more generally STEM, has been the focus of strong central influence in the last 10 to 15 years with very large numbers of interventions and stakeholders trying to add their own interventions into the mix.

Recommendation 6: *The landscape of interventions does not get any less complex with time, therefore all stakeholders – including policy makers, funders, researchers and practitioners – must increase their efforts to engage in open dialogue on interventions in order to establish need, effectiveness, quality and value for money. Particular consideration should be given to:*

- *revisiting ways to rationalise the number of interventions in science education, increasing the number of collaborative programmes*
- *developing an ‘intervention toolkit’, similar to that published by Education Endowment Foundation, specific to science education and designed to inform practitioners of the range in interventions available, the evidence base for their effectiveness and value for money.*

The challenge of implementing interventions successfully

The way in which interventions are implemented is considered central to their success and effectiveness but the perception is that the necessary expertise and time required is not always available.

Recommendation 7: *Greater emphasis must be given to ensuring that implementation of interventions is to the highest possible standard. In particular, more effort should be put into supporting schools and practitioners to ensure they:*

- *are party to the development of the intervention*
- *have the necessary expertise, skills and knowledge to make informed judgements on which interventions to choose, implementing and evaluating them by making better use of existing research and their own evidence and experience*
- *are engaged in relevant professional development for continuous improvement in their practice.*

The extent to which effective change management might contribute to successful interventions

Interventions are integral to bringing about change and so require change agents, leadership at all levels and commitment to make changes and embed them into ongoing practice. The wider issues of managing change are rarely considered in planning interventions.

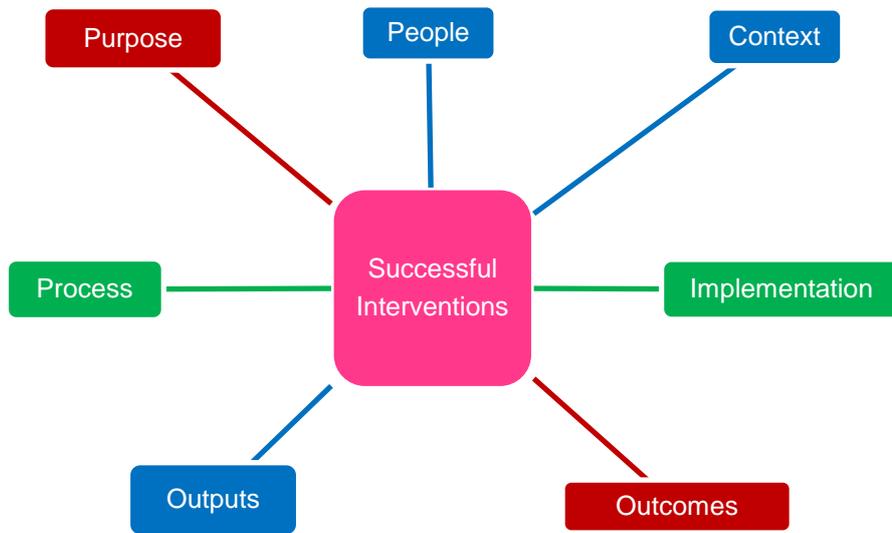
Recommendation 8: *Further research should be undertaken to understand better the processes which contribute to successful interventions, in particular, those which bring about effective and sustainable change in the behaviour of individuals and organisations.*

The need for a more holistic model for developing interventions

No intervention is perfect. The complex combination of factors influencing the outcomes and the diversity of criteria by which interventions might be judged render perfection impossible to achieve. However, based on the discussions presented in this report, there is scope to improve the current situation and raise the quality of interventions. The factors which contribute to success are the inputs to a process which has been (or should have been) designed to meet the objectives that have been determined for the intervention. The criteria are the outputs and outcomes that provide evidence of what has, or has not, been achieved as a result of the interventions.

The proposed model is an attempt to bring together the lessons derived from the discussions and to form the basis for developing successful interventions by setting the different elements in an overall context. The proposed model, Figure 1, envisages seven key elements, summarised in Table 2 overleaf, that contribute to a successful intervention.

Figure 1: A model for successful interventions



The seven elements all interact and contribute to the success of an intervention but, together, they can be considered to form three intersecting axes in which:

- the clarity of, and commitment to, the **purpose** lead to tangible impact and **outcomes**
- suitable **people** working in the right **context** results in measureable and demonstrable **outputs**
- robust **processes** lead to effective **implementation**.

Recommendation 9: *Consideration should be given to testing and refining such a model for developing interventions in order to explore in more depth ways in which interventions of all types can be made more successful.*

Although the perceptions of what makes interventions successful vary, the findings of this study suggest there is a broad consensus on the key elements required and the issues that are outstanding. Further work is required, however, to refine a framework for developing more successful interventions and to establish robust and reliable evidence to support claims of success.

Table 2: Elements of successful interventions

<p>Successful interventions have a clear purpose which:</p>	<ul style="list-style-type: none"> • matches a defined need (or needs) • is underpinned by shared values and principles • has an evidence-based rationale.
<p>Successful interventions are undertaken by people who:</p>	<ul style="list-style-type: none"> • have skills in leadership and management • have expertise and subject knowledge in pedagogy, curriculum and assessment • work collaboratively as a team and in partnership with other stakeholders • engage in the necessary continuing professional development to understand and implement the intervention effectively
<p>Successful interventions take into account the context by:</p>	<ul style="list-style-type: none"> • using evidence to identify the starting points and influential factors • building on the existing strengths • mitigating weaknesses • adapting to local factors.
<p>Successful interventions establish processes which:</p>	<ul style="list-style-type: none"> • enable robust and constructive dialogue • facilitate clarity of communication • allow for effective management of change • use evidence rigorously at all stages • build a respected profile for the intervention. • support high quality in all aspects.
<p>Successful interventions depend on effective implementation which:</p>	<ul style="list-style-type: none"> • is well planned with appropriate milestones • allows for changes in circumstances • monitors and shares progress, failures and achievements systematically • incorporates regular review cycles and acts on feedback information.
<p>Successful interventions result in outputs which:</p>	<ul style="list-style-type: none"> • are based on criteria specifically related to the objectives of the intervention • are definable and measurable • include short-, medium- and longer-term criteria appropriate to the stage, scale and context of the intervention.
<p>Successful interventions bring about change through their outcomes which:</p>	<ul style="list-style-type: none"> • provide evidence to demonstrate sustainable impact on engagement, teaching and learning • add to the evidence base and understanding • improve existing practice • inform practice in new contexts • provide feedback for future interventions.

