Development and evaluation of learning resources

Resources to teach primary school children in low-income countries to assess claims about treatment effects: Protocol for a process evaluation

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Colophon

Title  Resources to teach primary school children in low-income countries to assess claims about treatment effects: Protocol for a process evaluation

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☐ Learning resources
☐ Systematic reviews
☐ Claim questionnaire and evaluation tools
☐ Editorials and commentaries
☐ Grant applications

Date  October 2016
Abstract

**Background:** All of us - adults and children - are confronted with claims about the effects of treatments. Yet most of us lack the ability to understand and apply concepts that are essential for assessing these claims. As part of the Informed Health Choices project (IHC), we have developed primary school resources for children and an audio podcast for their parents to help address this problem. We are evaluating these resources in randomized trials and process evaluations in Uganda.

**Objectives:** To explore why the resources did or did not have intended effects and explain variations in effects, identify other potential adverse and beneficial effects than those that were measured in the trial, explore ways in which use of the primary school resources could be scaled up, and investigate the impact of the intervention on teachers and parents.

**Study design:** This is a multi-method study including qualitative and quantitative approaches.

**Data collection:** Data will be collected using evaluation forms that teachers using the school resources will complete after each lesson; classroom observations of at least one lesson being taught by each teacher using the resources; interviews with teachers, head teachers, district education officers, children and their parents; and focus groups with children and teachers who have used the resources. All the interviews and focus group discussions will be audio-recorded and transcribed.

**Sampling:** For quantitative analyses we will use data from all 60 schools randomized to use the IHC school resources in the trial (86 teachers and approximately 7000 children). For the qualitative analysis we aim to recruit 10% of the schools in the intervention arm (six schools). The schools will be sampled purposively based on their geographic location (rural, semi-urban, or urban) and ownership (public or private). We will interview all five district/regional education officers in the region where the trial is occurring, the six head teachers in the selected schools, and all of the grade-five teachers in those schools. We will purposively sample children in the selected schools to ensure variation in their end-of-term marks from the previous term and in how well they understood the IHC lessons. Parents will be sampled from participants in the trial of the IHC podcast.
Analysis: We will describe the fidelity of the intervention using quantitative data from the teachers’ evaluation forms and classroom observations, and use data from all the interviews and focus groups to gain a better understanding of factors related to fidelity. We will use multivariate and univariate regression analyses to explore variation in effects and look at the data from the interviews and focus groups for other potential factors that might have led to variation. We will use data from the podcast trial to measure effects of the school resources on parents, as well as interviews with parents and children to explore their experiences. We will use data from the Claim questionnaire to measure effects of the school resources on teachers, as well as interviews to explore their experiences. We will use the framework analysis approach to analyse potential adverse and beneficial effects, barriers and facilitators to implementing and scaling up use of the resources. We will use a logic model approach to organise the findings of this process evaluation with the findings of the trial. We will summarize the key findings of the process evaluation for each key finding from the qualitative analyses and assess our confidence in the finding using a modified version of the GRADE-CERQual approach.
Background

All of us - adults and children - are confronted with claims about the effects of treatments in their everyday interaction with individuals and through mass media. The majority of these claims are unsubstantiated, unreliable, inaccurate or biased. Failure to use treatments supported by reliable evidence may result in unnecessary suffering and waste scarce resources, especially in low-income countries. This could be avoided if people were able to assess treatment claims and make informed healthcare choices. However, several studies have shown that people commonly lack the ability to understand and apply key concepts that are essential for appraising claims about the effects of treatments.

The aim of the Informed Health Choices (IHC) project is to help address this problem by developing and evaluating learning resources to enable people to assess claims about treatment effects and make informed healthcare choices. We first developed a list of key concepts that people need to understand in order to assess claims about the benefits and harms of treatments. We then prioritized which of these concepts could and should be taught to primary school children and developed the IHC primary school resources to teach those concepts to grade-5 children (10 to 12 year olds). We developed the IHC podcast to teach some of the same concepts to the children’s parents. (A podcast is a serial programme, which is downloaded or streamed, rather than broadcast. In the trial, parents receive the podcast preloaded on MP3-players.)

Teaching primary school children to assess claims about treatments can capitalize on children’s curiosity and enthusiasm to learn, as well as provide opportunities to teach them. It might also have an indirect effect on their family members’ abilities to determine the reliability of claims. Moreover, teaching children to assess claims about treatment effects can provide a foundation for a more scientifically literate and healthier society.

We are evaluating the effects of IHC primary school resources on children’s ability to assess treatment claims in a cluster randomized trial in Uganda. In a linked randomized trial, we are evaluating the effects of the IHC podcast on the ability of parents of the primary school children to assess treatment claims. This protocol describes the methods that we will use in a process evaluation linked to the trial of the IHC primary school resources.
Methods

This will be a multi-method study using qualitative and quantitative data. We will use lesson evaluation forms completed by teachers; observation in classrooms that are using the resources; individual interviews with children, parents, teachers, head teachers and district education officers; focus group discussions with teachers and children; data from the randomized trial of the IHC primary school resources; and records of absenteeism and end of term results from schools on the four key subjects (English, Mathematics, Social Studies and Science).

*Figure 1. IHC Process Evaluation Flow Chart*
Objectives

The objectives of this process evaluation are to:

1. Explore why the resources did or did not have the effects that were intended, and explain variations in effects
2. Identify potential adverse and beneficial effects that were not measured in the trial
3. Explore ways in which use of the primary school resources could be scaled up, if they are found to be effective
4. Explore the impact of the intervention on teachers and parents

Framework for identifying factors affecting the implementation of interventions in schools

We have developed a framework for exploring why the resources did or did not have intended effects (Table 1). The framework has been developed iteratively by reviewing existing frameworks and studies of barriers and facilitators to implementing changes in schools,(16-20) and frameworks of barriers and facilitators to implement changes in health professional practice.(21) We will use this framework to guide data collection (i.e. as a basis for questions and prompts), to structure a qualitative analysis of why the resources did or did not have intended effects (Objective 1), and to explore barriers and facilitators to scaling up use of the resources (Objective 3).

Table 1. Framework for factors affecting the implementation of interventions in schools

<table>
<thead>
<tr>
<th>Domain</th>
<th>Factors and sources</th>
<th>Explanation</th>
<th>Questions (interview guide)/ method used*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>Skills and competencies(16, 17)</td>
<td>Teacher’s education and experience in relation to the lessons being taught</td>
<td>What sort of skills or competencies do you feel helped you teach this content in an effective way? (Question 3- Teachers’ Interview Guide)</td>
</tr>
<tr>
<td>Understanding of the content being taught(16)</td>
<td>Teacher’s understanding of the content</td>
<td></td>
<td>The content in the IHC books might have initially felt new and unfamiliar to many of the teachers who participated. How did the content in the IHC books feel to you? (Question 2- Teachers’ Interview Guide)</td>
</tr>
<tr>
<td>Sufficient training(11, 18)</td>
<td>The extent to which the teachers received sufficient training in teaching the lessons</td>
<td></td>
<td>What are your thoughts on the training you received in the delivery of the IHC lessons? (Question 4- Teachers’ Interview Guide)</td>
</tr>
<tr>
<td>Domain</td>
<td>Factors and sources</td>
<td>Explanation</td>
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</tbody>
</table>
| Self-efficacy | Teacher’s confidence in teaching the lessons | • Did you feel confident or uncertain about teaching these lessons? (Question 6 - Teachers’ Interview Guide)  
• Observation | |
| Fit to the teacher’s teaching style and context (e.g. class size) (11) | Teachers’ comfort with the instructions or ability to adapt the instructions to their style and context | • How did the way the IHC lessons were packaged and delivered fit or contradict your current teaching style? (Question B1 – Teacher’s Interview Guide)  
• Observation | |
| Attitudes(11, 17, 19) | Teachers’ attitude towards new material (change), science, critical thinking and independent thinking by pupils (or their role as authorities in the classroom) | • Did you experience any conflicts in the lesson content with your own beliefs about treatments, or about what children or others should be encouraged to do? (Question 8 - Teachers’ Interview Guide) | |
| Beliefs(19) | Teachers’ beliefs about the teaching methods or content (e.g. what treatments work or the concepts) | • Did you experience any conflicts in the lesson content with your own beliefs about treatments, or about what children or others should be encouraged to do? (Question 8 - Teachers’ Interview Guide)  
• In the recent past, your child may have asked you or a close relative about a treatment that you or the child were using! What was it about? How did it make you feel? (Parents’ Interview Guide - Question 5) | |
| Emotions(11, 17) | Teachers’ emotions, such as stress or anxiety | • Tell me a bit about how you felt teaching this material to your class. (Question 5 - Teachers’ Interview Guide)  
• What sort of discussions if any, have you had with your child/children in the recent past about the basis of diverse claims? (Parents’ Interview Guide - Question 4)  
• In the recent past, your child may have asked you or a close relative about a treatment that you or the child were using! What was it about? How did it make you feel? (Parents’ Interview Guide - Question 5) | |
| Motivation(16) | Teachers’ motivation to teach the material | • How motivated did you feel to teach these lessons to your class – very motivated or not so motivated?. (Question 7 - Teachers’ Interview Guide) | |
| Positive learning environment(11, 16) | Teachers’ ability to create a positive learning environment; e.g. encourage discussion, respond positively to questions, engage pupils | • Did you feel that you managed to engage the students during the lessons and get them thinking and discussing, or was this difficult to do with these lessons? (Question 9 - Teachers’ Interview Guide)  
• Observation | |
<table>
<thead>
<tr>
<th><strong>Domain</strong></th>
<th><strong>Factors and sources</strong></th>
<th><strong>Explanation</strong></th>
<th><strong>Questions (interview guide)/ method used</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils</td>
<td>Literacy (11)</td>
<td>Pupils’ ability to read and understand the material</td>
<td>• Children’s CLAIM questionnaire (English)/Children’s exercise books/Observation</td>
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<td>• Children’s CLAIM questionnaire (Luganda-Audio Questionnaire).</td>
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<td>• What helped you understand the IHC lessons better? Give me examples (Question 4-Children’s Interview Guide)</td>
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<td>• What was the most difficult lesson in the IHC materials? (Question 3-Children’s Focus Group Interview Guide)</td>
</tr>
<tr>
<td>Attendance</td>
<td>(11, 21)</td>
<td>Pupils’ attendance or reasons for poor attendance (e.g., long distance to school or inability to pay school fees)</td>
<td>• Classroom attendance records/Question 2 (Children’s Interview Guide)-Interview</td>
</tr>
<tr>
<td></td>
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<td>• How many of the nine IHC lessons did you attend? If not all of them, which lessons did you miss out? (Question 2-Children’s Interview Guide)</td>
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<td></td>
<td>• What helped you understand the IHC lessons better? Give me examples (Question 4-Children’s Interview Guide)</td>
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<tr>
<td>Motivation to learn (11, 16, 17, 19)</td>
<td>Pupils’ motivation to learn the new material</td>
<td></td>
<td>• What factors do you think motivated or demotivated your teacher(s) to take on the IHC lessons? (Question C1-Head teachers’ Interview Guide)</td>
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<td>• How did you find the IHC lessons that you attended in your class last term? (Question 1-Children’s Interview Guide)</td>
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<td>• What stood out for you about the IHC lessons? What was most memorable for you? (Question 5-Children’s Interview Guide)</td>
</tr>
<tr>
<td>Attitudes</td>
<td>(11, 17, 19)</td>
<td>Pupils’ attitudes towards learning, towards authorities, towards science, towards critical thinking</td>
<td>• How do you find school in general especially learning science? (Question 1-Children’s Interview Guide)</td>
</tr>
<tr>
<td>Beliefs</td>
<td></td>
<td>Pupils’ beliefs about the content (e.g., what treatments work or the concepts)</td>
<td>• What stood out for you about the IHC lessons? What was most memorable for you? (Question 5-Children’s Interview Guide)</td>
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<td>• Tell me some treatments that you know of that you think work for people and why? (Question 7-Children’s Interview Guide)</td>
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<td>• What sort of discussions if any, have you had with your child/children in the recent past about the basis of diverse claims? (Parents’ Interview Guide-Question 4)</td>
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<td><strong>Home environment</strong>(11)</td>
<td>The extent to which the pupil’s home environment encourages or discourages learning from the lessons</td>
<td>- How many of the nine IHC lessons did you attend? If not all of them, which lessons did you miss out? (Question 2- Children’s Interview Guide).</td>
<td>- Have you discussed any of the lessons with your parents or your siblings? Can you describe some different things that they said or that you talked about? (Question 9- Children’s Interview Guide).</td>
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<td>- How did you get to know about the IHC lessons that your child/children attended last term? (Parents’ Interview Guide- Question 2)</td>
<td>- What have you heard about the IHC lessons that your child attended at their school last term? (Parents’ Interview Guide- Question 3)</td>
</tr>
<tr>
<td><strong>Differentiated instruction</strong>(16)</td>
<td>The extent to which pupils different learning needs are met</td>
<td>- How did you find the IHC lessons that you attended in your class last term? (Question 1- Children’s Interview Guide)</td>
<td>- What helped you understand the IHC lessons better? Give me examples (Question 4- Children’s Interview Guide).</td>
</tr>
<tr>
<td><strong>Peer influence</strong></td>
<td>Positive or negative attitudes of other pupils towards the material</td>
<td>- Have you discussed any of the lessons with your friends? Can you describe some different things that you talked about? (Question 8- Children’s Interview Guide)</td>
<td>- What lesson did you like best as a class in general and why? (Question 2- Children’s Focus Group Interview Guide)</td>
</tr>
<tr>
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| Teaching materials            | Value of the material (22) | The extent to which the materials are valued by the teachers and pupils   | • How valuable were the resources overall for you as a teacher for use in your class and your school? (Question B.6- Teachers’ Interview Guide)  
• What stood out for you about the IHC lessons? What was most memorable for you? (Question 5- Children’s Interview Guide)  
• What did you like about the IHC materials that were given to you and your fellow classmates and why? (Question 1- Children’s Focus Group Interview Guide) |
| Compatibility with the curriculum (11, 18) | The extent to which the material fits with the rest of the curriculum and how it is taught | • Do you think these resources should be a part of the curriculum for this age group in your school? (Question B.7- Teachers’ Interview Guide)  
• In your own opinion, to what extent is the IHC program compatible with the current primary school curriculum? (Question B.2- Head Teachers’ Interview Guide) |
| Appropriateness of the material (23) | The extent to which the materials are relevant, challenging and engaging | • To what extent would you rate the IHC lessons as appropriate for children in your class? (Question B.4- Teachers’ Interview Guide)  
• Based on the information we gave you about the IHC materials and your interaction with the materials themselves (teachers’ guides, children’s text and exercise book). Do you find the IHC materials appropriate for primary five children in your school? (Question B.1- Head Teachers’ Interview Guide)  
• How suitable do you think the IHC lessons were for you and your fellow P.5 members? Give me a reason why? (Question 6- Children’s Interview Guide) |
| Credibility of the material (23) | The extent to which the teachers and pupils perceive the material as credible | • To what extent did you trust the content in the IHC materials? (Question B.4- Teachers’ Interview Guide)  
• What did you like about the IHC materials that were given to you and your fellow classmates and why? (Question 1- Children’s Focus Group Interview Guide) |
<table>
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</table>
| School system and environment| Time constraints    | The extent to which there is sufficient time to accommodate introducing the new material                                                        | • How *easy or difficult was it for you to take on and to teach* the IHC lessons in addition to all your other responsibilities at the school?  
(Question D.1 - Teachers’ Interview Guide)  
• Based on both your current position as the school head, and your school’s recent participation in teaching the IHC lessons, what were your main challenges when introducing IHC lessons onto your school time table?  
(Question 1 - Head teachers’ Interview Guide) |
| Competing priorities(18)    |                     | The extent to which other priorities for the school, teachers or pupils limit introducing the material (e.g. preparing for exams)              | • Besides time constraints, were there other factors that made it difficult to teach these lessons in your school, such as  
- lack of support/interest from your leaders  
- lack of support/interest from your peers  
- lack of support/interest from parents or community  
- other barriers?  
(Question D.2 - Teachers’ Interview Guide)  
• Based on both your current position as the school head, and your school’s recent participation in teaching the IHC lessons, what were your main challenges when introducing IHC lessons onto your school time table?  
(Question 2 - District Educational Officers’ Interview Guide) |
| School organisation and management (11, 18, 20, 21) |                     | The extent to which the school provides an environment that supports adoption of new subjects, material and teaching methods                | • Besides time constraints, were there other factors that made it difficult to teach these lessons in your school, such as  
- lack of support/interest from your leaders  
- lack of support/interest from your peers  
- lack of support/interest from parents or community  
- other barriers?  
(Question D.2 - Teachers’ Interview Guide)  
• Based on your experience as the District (Division) Education Officer, what sort of beauracratic arrangements are responsible for limiting or facilitating the introduction of new materials in schools in your district or division?  
(Question 2 - District Educational Officers’ Interview Guide). |
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<tr>
<td>School resources, particularly human resources (11, 17, 18, 21)</td>
<td>The extent to which the school has adequate resources to introduce the new materials (e.g. human resources, student/teacher ratio, teacher workload, classroom space and classroom resources, such as blackboards and accoustics)</td>
<td>• How capable do you think the schools in your district/region are for taking on new interventions? (Question 4 - District Educational Officers’ Interview Guide).</td>
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<tr>
<td>Attitudes and beliefs of head teacher and other teachers</td>
<td>Attitudes or beliefs of colleagues that influence the teacher’s interest in and ability to teach the material</td>
<td>• What are your thoughts on having educational interventions evaluated in schools before being rolled out on a large scale? (Question 5 - District Educational Officers’ Interview Guide).</td>
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<tr>
<td>Parent and community involvement(11)</td>
<td>Parents’ attitudes towards the new material or how things are done at the school</td>
<td>• Have you heard about the IHC lessons that primary five children at your child’s school attended last term? (Parents’ Interview Guide - Question 1)</td>
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<td>• How did you get to know about the IHC lessons that your child/children attended last term? (Parents’ Interview Guide - Question 2)</td>
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<td><strong>Prompts!</strong></td>
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<td>Who was the source of information? The child, the teacher or a fellow parent?</td>
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<td>If (child): How did the child tell you about what they were studying at school?</td>
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<td>Did they show you the materials (books) they were using, what did you think of the materials?</td>
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<td>If (teacher): How were you informed by the teacher about the IHC lessons?</td>
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<td>If (fellow parent): What did the fellow parent tell you about the IHC lessons?</td>
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<td>• What did you share with your parents or people at home about what you learnt in the IHC lessons? (Children’s Focus Group Interview Guide - Question 5)</td>
<td></td>
</tr>
<tr>
<td>Regulations (21)</td>
<td>Regulations (e.g. Ministry of Education policies and regulations) that affect introducing the new material</td>
<td>• What policies or regulations if any by the Ministry of Education or Regional Education Authorities do you think may have affected or hindered the way the IHC lessons were delivered at your school? (Head teachers' Interview Guide - Question 3)</td>
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<td>• What do you envision to be the main challenges for the IHC materials if they were to be rolled out in all the schools in your districts? (Question 6 - District Educational Officers’ Interview Guide)</td>
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<tr>
<td>Domain</td>
<td>Factors and sources</td>
<td>Explanation</td>
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<tr>
<td>Political environment (11, 21)</td>
<td>Elements of the political environment that affect introducing the new material; e.g. authoritarianism or teacher strikes</td>
<td>• What do you envision to be the main challenges for the IHC materials if they were to be rolled out in all the schools in your districts? (Question 6 - District Educational Officers’ Interview Guide)</td>
<td></td>
</tr>
<tr>
<td>Bureaucracy (21, 24)</td>
<td>Bureaucratic arrangements that delay or limit introduction of the new materials, or facilitate introducing them</td>
<td>• Based on both your current position as the school head, and your school’s recent participation in teaching the IHC lessons, what were your main challenges when introducing IHC lessons onto your school time table? (Question 2 - District Educational Officers’ Interview Guide) • What do you envision to be the main challenges for the IHC materials if they were to be rolled out in all the schools in your districts? (Question 6 - District Educational Officers’ Interview Guide).</td>
<td></td>
</tr>
<tr>
<td>Incentives and disincentives (11, 21)</td>
<td>Incentives or disincentives to introduce the new materials for teachers or head teachers</td>
<td>• What incentives or disincentives were there for teaching these lessons? (Question 10 - Teacher’s Interview Guide) • If you were to teach these lessons again, can you think of other incentives or disincentives for doing this? (Question 11 - Teacher’s Interview Guide)</td>
<td></td>
</tr>
</tbody>
</table>

* The question number references are for the individual interview guides, but the same questions are included in the focus group guides. All interview guides will be subject to adjustment as data collection progresses.
Potential adverse and beneficial effects

Use of the IHC school resources might have either adverse effects or beneficial effects that were not measured in the trial, or both. These might be effects on relationships between children and others, on beliefs, attitudes or behaviours. We have developed an initial list of potential effects that we will explore based on pilot and user testing of the resources; discussions with education researchers, policymakers and teachers; and reviewing the literature:

Table 2. Potential adverse and beneficial effects

<table>
<thead>
<tr>
<th>Potential adverse effects</th>
<th>Corresponding beneficial effects</th>
<th>Questions (Interview Guide) - Method used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conflict between children and teachers due to children challenging their teachers</td>
<td>More open and engaging discussion of the basis of diverse claims or beliefs</td>
<td>All the interview guides (except for the children’s) have a section of questions and prompt lists regarding adverse and beneficial effect.</td>
</tr>
<tr>
<td>Conflict between children and parents due to children challenging their parents</td>
<td>Better understanding between children and parents about what they are learning and parents feeling more engaged with what their children are learning + engagement of parents in discussions of health issues</td>
<td>Question example from the Parents interview Guide: “With the information that you have about the IHC lessons that your child attended last term, what do you envision as potential adverse and beneficial effects if any to the children attending the IHC lessons?”</td>
</tr>
<tr>
<td>Distrust of health professionals or conflict between children and health professionals</td>
<td>Appropriate questioning of health professionals, better understanding and better healthcare</td>
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<tr>
<td>Conflict due to undermining of religious beliefs</td>
<td>Engagement of children and others in discussion about religious beliefs and science</td>
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<tr>
<td>Shortened enjoyment of the innocence of childhood</td>
<td>Increased enjoyment of school and childhood</td>
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<tr>
<td>Nihilism or cynicism</td>
<td>Healthy scepticism and appreciation of science</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Other potential beneficial effects</th>
<th>Questions (Interview Guide) - Method used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts on teachers</td>
<td>The learning resources might improve the teachers’ understanding and ability to apply the concepts being taught to the children</td>
</tr>
<tr>
<td>Impacts on parents</td>
<td>The learning resources might indirectly improve parents’ understanding and ability to apply the concepts being taught to the children</td>
</tr>
<tr>
<td>Assertiveness</td>
<td>Children asking more questions and not taking things for granted</td>
</tr>
<tr>
<td>Improved decision-making</td>
<td>Children making more thoughtful and informed decisions</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Nonviolent conflict resolution</td>
<td>Claims being presented and addressed in a friendly manner even when there is a disagreement about the claim, as illustrated in the resources</td>
</tr>
<tr>
<td>Friendship formation</td>
<td>Friendly interactions between adults and children and among children, as illustrated in the resources</td>
</tr>
<tr>
<td>Collaboration for problem solving</td>
<td>Collaboration for problem solving among the children, as illustrated in the resources</td>
</tr>
<tr>
<td>Creativity</td>
<td>Thinking outside the box</td>
</tr>
<tr>
<td>Numeracy</td>
<td>Improvements in numeracy, reflecting what is learned in lessons 6 and 7 (on fair comparisons and the play of chance)</td>
</tr>
<tr>
<td>End of term report cards (Term I and Term II)</td>
<td></td>
</tr>
</tbody>
</table>

We will explore these and other potential adverse and beneficial effects in the interviews and focus group discussions. These include potential impacts on teachers and parents, and potential beneficial effects identified by the National Curriculum Development Centre in Uganda.

**Sampling**

To help us better understand interactions between factors that might impact on the fidelity of the intervention and the effects of the resources, we will create school-based case studies by selecting head teachers, teachers, children and parents from the same schools, and observing classes in those schools twice. We plan to sample six schools (10% of the schools) in the intervention arm of the IHC primary school resources trial. Within those schools we plan to include all of the head teachers and teachers and to sample two children and two parents. We will carry out at least one focus group discussion at each school for the children and two focus group discussions for teachers. Six schools (cases) will allow for variation across geographic locations and ownership, as well as the extent to which teachers used the resources as intended.

In order to capture the opinions, views and experiences of a wide range of participants,(25) we will purposively sample the six schools based on geographical location (rural, semi-urban, or urban) and ownership (public or private). We will also sample schools with variation in the extent to which teachers use the resources as intended. These judgments will be based on observations at all of the schools made at the beginning of the trial. Within schools, we will sample children with variation in end of term examinations.
from the previous term, and based on how well they understood the IHC lessons. We will assess how well they understood the IHC lessons based on how they performed on the exercises in the resources and in the perceptions of the teachers. We will sample parents from participants in the IHC podcast trial with variation in level of education (primary education and below, secondary school education or tertiary education). We will include all of the head teachers and teachers in the selected schools and all of the five district education officers in the central region of Uganda, where the trial took place.

The number of interviews (approximately 12 children and 12 parents) and focus group discussions (approximately 8) is largely pragmatic. There is some evidence that suggests that it is possible to reach saturation with somewhere between 6 and 12 interviews. However, the concept of saturation has been criticised for being too vague to operationalise and rules of thumb may not be empirically justified. Within the six schools chosen for the reasons given above, we will make a judgement based on the emerging data on whether more interviews or focus groups are needed. In making this judgement, we will consider the variation in issues emerging from the interviews and focus groups and the extent to which we are able to explain these variations. Similarly, we will judge whether more schools are needed. However, due to time and resource constraints, and in order not to end up with very large volumes of data that cannot be easily managed or analysed, we are unlikely to include many more than six schools or interview many more than 12 children or parents or to carry out many more than eight focus group discussions.

Data collection

**Objective 1. Explore why the resources did or did not have the effects that were intended, and explain variations in effects**

To explore why the resources did or did not have the intended effects, we will use three approaches:

A. Assess the fidelity of the intervention
B. Examine an additional set of factors that might reduce the effect of the intervention
C. Explore potential implementation barriers and facilitators from the perspective of different groups of stakeholders
Objective 1A. Fidelity of the intervention - data collection

Data collection will start concurrently with the trial. We will use the following methods to collect data to assess the fidelity of the intervention.

**Teacher evaluation forms:** Teachers in the intervention group of the trial who are using the resources will be asked to complete an evaluation form after each lesson (Appendix 1). The evaluation form will include self-evaluation questions about how well the teacher prepared for and taught the lesson, questions evaluating the resources, and questions about their perceptions of how well the children succeeded in achieving the lesson objectives.

**Classroom observations:** Each class in the 60 schools in the intervention group of the trial will be observed at least once by a trained research assistant or one of the investigators (AN or DS) early in the trial. In addition, we will observe approximately six classes a second time, after the teachers have become more familiar with using the resources. The observers will use data collection forms to note how well the teachers adhere to the lesson plan, any problems that the teachers or children have with the lesson, and any aspects of the lesson that go particularly well (Appendix 2). They will also note the extent to which the children follow the lesson and participate actively. After the lesson, they will collect the exercise books and record how well the children did on the exercises for the lessons that they have observed.

To gain a better understanding of issues related to fidelity, we will use qualitative data collected in the interviews and focus groups. (See Objective 1C below).

Objective 1B. Factors that might reduce the effect of the intervention – data collection

We have identified a set of factors (Table 3) that might reduce the effect of the intervention, even if the set of lessons was carried out according to schedule and instructions. The factors were derived iteratively by reviewing existing frameworks; published literature; and deliberations with teachers, educational researchers and the study investigators.
### Table 3. Factors that might reduce the effect of the intervention

<table>
<thead>
<tr>
<th>Factors</th>
<th>Explanations</th>
<th>Questions (Interview Guide)/Method used</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attendance</strong> across schools. We will analyse this as a continuous variable.</td>
<td>Schools with lower attendance are expected to score lower.</td>
<td>Classroom attendance records/</td>
</tr>
<tr>
<td><strong>Teachers scores on Claim questionnaire across classes. We will analyse this as a continuous variable.</strong></td>
<td>Classes with teachers who score lower are expected to have lower scores.</td>
<td>Teachers’ CLAIM questionnaire</td>
</tr>
<tr>
<td><strong>Reading skills of the pupils</strong> across pupils, based on four questions used to assess this in the Claim questionnaire</td>
<td>Pupils with poorer reading skills are expected to score lower.</td>
<td>Children’s CLAIM questionnaire - English Children’s CLAIM questionnaire - Luganda</td>
</tr>
<tr>
<td><strong>End of term examination marks across pupils, aggregated across English, mathematics, social studies and science (divided into five categories)</strong></td>
<td>Pupils with lower marks are expected to score lower.</td>
<td>End of term report card</td>
</tr>
</tbody>
</table>

**Attendance:** We will ask participating schools to provide us with school attendance data. Schools keep a daily attendance record for the number of pupils in attendance that day, but do not keep attendance record for individual pupils. We will convert these data into the average percent of students in attendance daily during the term.

**Teachers scores on Claim questionnaire:** We will ask the teachers in both the intervention and comparison schools to complete the Claim questionnaire and use their scores on the 24 multiple-choice questions that cover the 12 Key Concepts covered by the IHC primary school resources (from 0 to 24 correct answers).

**Reading skills:** We will use four questions in the Claim questionnaires to categorise pupils as having advanced reading skills (all four literacy questions in the evaluation tool answered correctly), basic reading skills (both basic questions correct and one or two of the advanced reading questions wrong), or lacking basic reading skills (one or both of the basic reading skills questions wrong).

In addition to the above quantitative analysis, we shall also use scores of 10% of all the children in both arms of the trial who attempted both versions of the Claim questionnaires (English and Luganda version). We shall compare the percentage of children who obtain a score that indicates either a pass or mastery of the concepts in both versions of the Claim questionnaire.

**End of term marks:** We will ask the participating schools to provide us with summary score sheets containing all pupils’ grades for the previous term. The summary score sheet contains percentage scores for each end of term.
examination, each pupil’s position in class, and a total score aggregated across pupils. The aggregated scores are divided into Division 1 (highest) to Division 4 (failure).

To identify other potential factors that might have lead to variation in effect, we will use qualitative data collected in the interviews and focus groups. (See Objective 1C below).

**Objective 1C. Barriers and facilitators to implementation – data collection**

We will conduct a set of interviews with district education officers, head teachers, teachers, children, parents, as well as set of focus groups with children and teachers. We will also conduct interviews with the lead investigators. We have chosen to only use face-to-face interviews to obtain in-depth data from district education officers and head teachers because it would not be feasible to organize group discussions with these groups.

For all of the interviews and focus group discussions, one of the study investigators (AN or DS) will carry out the interview or facilitate the discussion. A research assistant will be responsible for observation and note taking. All of the interviews and focus group discussions will be conducted in English except for the parents’ interviews (which may be conducted in English or Luganda depending on the parent’s language of preference).

We will audio record and transcribe all of the interviews and focus group discussions.

**Interviews with district education officers, head teachers and teachers:**

We will conduct face-to-face interviews with all five district education officers, approximately six head teachers and six grade five teachers who used the IHC primary school resources in the trial. We will collect these data following completion of the intervention (which includes nine lessons).

Using semi-structured interview guides, we will conduct face-to-face interviews to elicit the views of district education officers, head teachers and teachers (Appendix 3, 4 and 5). The guides will focus primarily on questions related to barriers and facilitators (Table 1), and strategies for scaling up use of the resources. They will also include questions about potential adverse and beneficial effects (Table 2), and ways in which use of the resources could be rolled out to other schools that did not participate in the trial. The interviewer will include prompts for each of the domains and factors in the frameworks above. The interviewees will be asked to reflect on their experience and perceptions from their different perspectives.
A summary of each interview will be provided to the interviewee for further comment.

**Interviews with children:** We will use a semi-structured interview guide for face-to-face interviews to elicit the views of children who used the IHC primary school resources in the trial (Appendix 6). We will interview approximately 12 children, two from each of the six schools in the process evaluation. We shall aim to spend no more than 45 minutes with each child during the interview.

**Focus group discussions with children and teachers:** We will use focus group discussions with children and teachers to explore barriers and facilitators to using the resources, as well as potential adverse and beneficial effects (Objective 2). We will carry out approximately six focus group discussions involving children and two with teachers. The focus group discussions will comprise of 7-8 participants, with clear ground rules (including confidentiality) agreed in advance. Each group will be moderated by a facilitator using a guide (Appendix 7 and 9) and assisted by an observer who will take notes. We shall aim to spend no more than an hour with the children during the focus group discussions and not more than two hours with the teachers.

We will start with a couple of interviews and use the issues emerging from those data to revise the questions in the guide for the focus group discussions, and to create prompts for the discussions. We will conduct further interviews after we have conducted some focus group discussions and have some preliminary findings from these. This will allow us to explore issues for which more detailed data are needed, or to capture the views of particular subgroups (e.g. poorer children or children who are not doing well in class). As noted above (under 'Sampling'), we will make a judgement, based on the emerging data, on whether more interviews or focus groups are needed.

**Interviews with parents:** We will use a semi-structured interview guide for face-to-face interviews to elicit the views of parents whose children used the IHC primary school resources in the trial (Appendix 8). This interview guide will include questions about the parents’ perspectives on how the resources were used, barriers and facilitators to their use, potential adverse and beneficial effects, and potential effects of the school resources on parents.

We will interview approximately 12 parents of children who used the IHC primary school resources in the trial. The parents will be selected from participants in the podcast trial. We will include both parents who listened to the IHC podcast series and parents in the comparison group of the podcast trial, who did not listen to the podcast series. The parent’s interviews will be
conducted in either English or Luganda based on the individual parent’s preferred language of communication.

**Interviews with the lead investigators:** AN and DS are responsible for implementing the intervention in the field. Given the importance of their role in the trial and the process evaluation, one of the other investigators (MK) will interview them periodically to make sure that we are capturing their thoughts and experiences along the way. Data from these interviews will be used in the analysis and the interviews will incorporate reflection on the findings from the other data sources.

**Objective 2. Potential adverse and beneficial effects**

We will use the qualitative data collected from the interviews and focus groups as described above. All the interview guides (except the children’s) include questions about potential adverse and beneficial effects.

**Objective 3. Ways to scale up use of the resources**

We will use the qualitative data collected from the interviews and focus groups as described above. The interview guides for district managers, head teachers and teachers include questions about scaling up.

**Objective 4. Explore the impact of the intervention on teachers and parents**

In exploring the impact on the intervention on teachers and parents, we will use both quantitative and qualitative data.

We will use the teachers’ scores on the Claim questionnaire to measure effects on teachers. We will use parent’s scores from the Claim questionnaire in the podcast trial to measure effects of the school resources on parents. We will use the qualitative data from the interviews and focus groups described above to explore the teachers’ and parents’ experiences.
Analysis

For an overview of the individual analyses, see Figure 3 at the end of this section.

**Objective 1. Explore why the resources did or did not have the effects that were intended, and explain variations in effects**

To establish what the effects were, we will use data from the Claim questionnaires, which the children will complete at the end of the term, as the primary outcome measure for the trial.

We will assess the fidelity of the intervention. We will also explore quantitatively the extent to which the variables in Table 3 might have reduced the effect of the intervention and might explain variation in its effects.

Qualitative data from classroom observations, interviews and focus groups will be analysed using the framework thematic analysis approach to identify possible implementation barriers and facilitators that might have mediated the effectiveness of the intervention. This data might also point to factors that could have contributed to variation in effect sizes, but will not be sufficient to provide explanations for this purpose. This data may also provide insights about factors contributing to more or less fidelity of the intervention.

**Objective 1A. Fidelity of the intervention - analysis**

This will be a descriptive analysis of the extent to which the school resources were used as intended (based on what is suggested in the Teachers’ Guide)(26). We will have data for all 60 schools in the intervention arm of the trial and we will summarise these data quantitatively, using Carroll and colleagues’ conceptual framework, which defines fidelity (or adherence) as a combination of content, frequency and duration of delivery, and coverage.(27, 28)

We will use the qualitative data from the interviews and focus groups to inform potential explanations for there being more or less fidelity of the intervention. Factors relating to fidelity will be coded from the interviews and focus groups and summarised qualitatively. See Objective 1C below for a description of how we will analyse the qualitative data.
Objective 1B. Factors that might reduce the effect of the intervention - analysis

We will explore potential effect modifications by the five pre-specified variables in Table 3: attendance, fidelity, teachers' scores using the Claim questionnaire, pupils' reading skills and end of term marks. The expected direction of these modifications, specified in Table 3, are based on logic. Scores on the Claim questionnaire (between 0 and 24) will be the dependent variable,(12) and the five factors in Table 3 will be the independent variables in regression analyses. We will first test the effect of each factor individually. Because we anticipate that the pre-specified variables will be highly correlated, we will then use a
backward stepwise approach, including all the pre-specified variables and potential interactions into the mixed model after adjusting for clustering. This will allow us to explore the extent to which each factor modifies the effect when controlling for the other factors.

We will interpret and report these analyses cautiously, using explicit criteria for subgroup analyses to assess the credibility of any factors that appear to explain variation in effects.\(^{(29,30)}\)

Qualitative data from the interviews and focus groups may point to other factors that might have contributed to variation in effect sizes. These will be coded from the interviews and focus groups and summarised qualitatively, but will not be sufficient to provide explanations for this purpose. See description of analysis for Objective 1C below.

**Objective 1C. Barriers and facilitators to implementation - analysis**

The following text is describes the analysis for Objective 1C, but the same analysis method will be used to for all objectives.

The interviews and focus group discussions will be coded by two of the investigators (AN and DS). We will analyze the data from the observations, interviews and focus group discussions using the framework analysis approach,\(^{(31)}\) and an a priori framework to guide the thematic analysis. Framework analysis has five stages:

- **i) Familiarisation** - Two of the investigators (AN and DS) will immerse themselves in the data by reading the transcripts repeatedly with these objectives in mind.

- **ii) Identifying a framework** – We will start with the framework of barriers and facilitators to implementing interventions in schools (Table 1). Factors from this framework will be coded from the interviews and focus groups and summarised qualitatively.

- **iii) Indexing** – AN and DS will independently read and re-read the transcripts and apply the framework, moving between the data and the barriers and facilitator factors covered by the framework, but also searching for additional factors until all the transcripts have been reviewed. The definitions and boundaries of each of the emerging factors will be discussed among the investigators. The framework will then be revised in line with the ideas and categories that emerge.
iv). **Summarizing data in the framework** - We will then summarize the data by rearranging it according to the appropriate part of the framework to which they relate. The summary will contain distilled summaries of the findings from different stakeholder perspectives.

v) **Mapping and interpretation** - Using the summarized data we will define concepts, map the range and nature of phenomena, create typologies and find associations between themes as a way of developing explanations for the findings. The process of mapping and interpretation will be influenced by the objective as well as by the themes that emerge from the data.

**Objective 2. Potential adverse and beneficial effects - analysis**

We will start with the framework of potential adverse and beneficial effects (Table 2). Evidence of potential adverse and beneficial effects will be coded from the interviews and focus groups and summarised qualitatively, using the same analysis method described above for Objective 1C.

**Objective 3. Barriers and facilitators to scaling up use of the resources - analysis**

Issues related to scaling up the use of resources will be coded from the interviews and focus groups and summarised qualitatively. See qualitative data analysis described above for Objective 1C.

**Objective 4. Impact on teachers and parents - analysis**

We will use teachers’ scores on the Claim questionnaire collected at the end of the primary school resources trial, and parents’ scores on the Claim questionnaire from the podcast trial. For the teachers, we will use a t-test to compare the scores of teachers of children in the intervention schools to those in the comparison schools. For the parents, we will use regression analysis, with exposure to the podcast (yes/no) and exposure of the child to the primary school resources (yes/no) as independent variables and Claim scores as the dependent variable.

Teachers’ and parents’ experiences will be coded from the interviews and focus groups and summarised qualitatively. See qualitative data analysis described above for Objective 1C.
Figure 3. Individual analyses

Objectives:
1. Explore why the resources did or did not have the effects that were intended, and explain variations in effects.
2. Identify potential adverse and beneficial effects that were not measured in the trial.
3. Explore ways in which one of the primary school resources could be scaled up, if they are found to be effective.
4. Explore impacts on teachers and parents.

Analyses:
- Fidelity analysis
  - Quantitative analysis of fidelity: Adherence, Coverage, Frequency, Duration
  - Qualitative analysis: Fidelity, Attendance, Teachers’ scores on CLAIM, Reading skills, End of term marks
- Variation of effect analysis
  - Quantitative analysis of variation of effect: Factors that might reduce the effect of the intervention: Fidelity, Barriers, Facilitators, Implementation
  - Qualitative analysis: Qualitative analysis of the interviews from all stakeholders to explore issues related to: Fidelity, Variation of effect
- Barriers and facilitators analysis
  - Qualitative analysis: Qualitative analysis of the interviews from all stakeholders to explore issues related to: Barriers, Facilitators
- Potential adverse effects analysis
  - Qualitative analysis: From the interviews with all stakeholders.
- Potential beneficial effects analysis
  - Qualitative analysis: From the interviews with all stakeholders with emphasis on the ones from head teachers and district educational officers.
- Scaling up analysis
- Implementation considerations for scaling up analysis
- Impact on teachers analysis
  - Quantitative analysis: CLAIM results for teachers
  - Qualitative analysis: From the interviews with teachers
- Impact on parents analysis
  - Quantitative analysis: CLAIM results for parents
  - Qualitative analysis: From the interviews with parents
Integration of the findings of the process evaluation with the findings of the trial

We will use a logic model approach to organise the findings of this process evaluation with the findings of the trial. First AN and DS will organise the findings into chains of events that might lead to the outcomes of the trial and additional outcomes that will be explored under Objective 2 of this study (Potential adverse and beneficial effects). Findings and outcome measures will be categorised as follows:

- Components or planned elements of the intervention
- Intermediate outcomes that the components might lead to, such as fidelity
- Important outcomes, including the primary outcome measures and other outcomes that are considered important
- Moderators, or barriers and facilitators, that could affect the relationship between the components of the intervention and intermediate or important outcomes

The investigators will then organise these elements into chains of events, discuss these, and then revise them iteratively until there is agreement on a final model.

Appraisal of the certainty of the findings of the process evaluation

We will summarize the key findings of the process evaluation and for each key finding from the qualitative analyses. We will assess our confidence in the finding using a modified version of the GRADE-CERQual approach.(32) Although CERQual has been designed for findings emerging from qualitative evidence syntheses, we anticipate that several components of the approach will also be suitable for findings based on multiple sources of qualitative data (observations; interviews with children, parents, teachers, head teachers, district education officers and the lead investigators; and focus group discussions with teachers and children).
References


7. Austvoll-Dahlgren A NA, Semakula D. Key concepts that people need to understand to assess claims about treatment effects: A systematic mapping review of interventions and evaluation tools. Systematic Reviews, submitted. 2015.


