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Feasibility of teaching critical thinking about health in Italian schools to 9-13-year-olds: a mixed-methods study across three regions

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Summary. Introduction. The Informed Health Choices (IHC) group developed key concepts of critical health literacy, gathered them into learning resources, and evaluated them in a large, randomized study involving children aged 10 to 12. Children who were taught with IHC resources showed a greater ability to assess health claims and understand an informed health choice than children not taught with these resources. Many research groups worldwide are implementing the IHC resources in their school contexts. **Methods.** In Italy, after an initial contextualization of the IHC resources in a single primary school in Tuscany, we carried out a second study across three regions. Our objectives were to: 1) investigate the feasibility of introducing IHC resources in primary and secondary schools; 2) evaluate students' and teachers' experiences with these educational resources; 3) identify effects, barriers, and facilitators regarding the implementation of IHC resources in Italian primary and secondary schools. To assess these objectives, we used qualitative and quantitative methods. **Results.** Qualitative and quantitative analysis indicated that IHC resources integrated well into the curriculum of the participating Italian schools. Students and teachers had a highly positive experience with the IHC resources, despite varying regional socioeconomic contexts. Teachers identified logistical challenges during the pandemic as the main obstacle to the project's implementation. Students and teachers highlighted the multicultural nature of the content, support from healthcare professionals during lessons, and the interactive teaching approach as key facilitators of implementation. **Conclusions.** Findings from the contextualization of IHC resources indicate that these materials integrate well into the Italian school curriculum and are suitable and engaging for both students and teachers.

Key words. Critical health literacy, critical thinking, evidence-based medicine, health literacy, informed health choices, public health, school, students.

Fattibilità dell'insegnamento del pensiero critico sulla salute nelle scuole italiane per bambini dai 9 ai 13 anni: uno studio con metodo misto in tre regioni.

Riassunto. Introduzione. Il gruppo Informed Health Choices (IHC) ha elaborato alcuni concetti chiave di alfabetizzazione sanitaria critica, li ha riuniti in risorse didattiche e li ha valutati in un ampio studio randomizzato coinvolgente bambini dai 10 ai 12 anni. I bambini a cui erano stati insegnati i concetti chiave sono risultati più capaci di valutare le affermazioni sulla salute e comprendere un processo decisionale informato rispetto ai bambini che non avevano ricevuto questo insegnamento. Molti gruppi di ricerca nel mondo stanno implementando queste risorse nel loro contesto scolastico. **Metodi.** In Italia, dopo una prima contestualizzazione delle risorse didattiche in una singola scuola primaria in Toscana, abbiamo svolto una seconda attività in più regioni. Il nostro obiettivo era: 1) indagare la fattibilità di introdurre le risorse IHC nelle scuole primarie e secondarie; 2) valutare l'esperienza di studenti e insegnanti con le risorse didattiche; 3) evidenziare effetti, barriere e facilitazioni riguardo all'implementazione delle risorse IHC nella scuola primaria e secondaria in Italia. Per valutare questi obiettivi abbiamo impiegato un metodo misto, qualitativo e quantitativo. **Risultati.** L'analisi mista ha indicato che le risorse IHC si sono inserite bene nel curriculum delle scuole italiane partecipanti. L'esperienza di studenti e insegnanti con le risorse didattiche e i concetti chiave è stata molto positiva pur nei differenti contesti socioeconomici regionali. I docenti hanno indicato le difficoltà logistiche del periodo pandemico come l'ostacolo principale all'applicazione del progetto. Il contesto multiculturale dei contenuti, il supporto di personale sanitario nel corso delle lezioni e la modalità interattiva dell'insegnamento sono stati indicati da studenti e docenti come facilitazioni all'implementazione. **Conclusioni.** I risultati della contestualizzazione delle risorse didattiche IHC mostrano che queste risorse si integrano bene nel curriculum scolastico italiano e risultano adatte e coinvolgenti per studenti e insegnanti.

Parole chiave. Alfabetizzazione sanitaria, alfabetizzazione sanitaria critica, medicina basata sull'evidenza, pensiero critico, salute pubblica, scelte sanitarie informate, scuola, studenti.

Introduction

It's not easy to make sense of the multiple health claims that inundate us daily from multiple sources. In fact, most of these claims, when analyzed properly, turn out to be unreliable. For example, a recent systematic review and meta-analysis on the quality of information in news media reports about the effect of health interventions showed that many news reports gave an unbalanced and oversimplified picture of the potential consequences of these interventions[1].

Unreliable health claims do not help people make informed and tailored health choices. On the contrary, by promoting incorrect health decisions, they may lead people to harm, suffering, and inappropriate use of health resources.

Over the past decades, people's willingness to actively participate in their own health decisions has been noticeably growing[2], but this increase hasn't been paralleled by educational efforts aimed at teaching people think critically about health. In fact, health literacy research shows that most people are scarcely equipped to critically approach health claims and health choices[3,4].

To overcome these issues, an international and multidisciplinary research team has developed and evaluated Informed Health Choices (IHC) educational resources with the aim of helping people think critically about health claims and health choices, starting from primary school[5].

Resources aim to teach content drawn from a list of Key Concepts (annually updated until 2022) that provide a basis to critically appraise health claims and treatments and to make informed health choices[6,7]. In 2012, together with a network of primary school teachers, the IHC team selected 12 of these Key Concepts with the objective of developing learning resources to teach these critical skills to primary school students (table 1). The main learning resources that resulted from this process are "The Health Choices Book", "The Exercise Book", and "The Teachers' Guide"[8,9] (figures 1, 2, 3).

"The Health Choices Book" is a textbook that employs a comic narrative, detailing the story of two siblings, John and Julie, who meet two educators and health researchers, Professor Compare and Professor Fair. Throughout the storyline, the professors guide the children through the questions they should ask when someone makes a claim about a health treat-

Table 1. The 12 Key Concepts that are taught in the IHC primary school resources.

Main concept group	Key Concept
Recognising **claims** about the effects of treatments that have an unreliable basis	*1.Treatments may be harmful*
	2. Personal experiences or anecdotes (stories) are an unreliable basis for assessing the effects of most treatments
	3. Widely used treatments or treatments that have been used for a long time are not necessarily beneficial or safe
	4. Brand-named, or more expensive treatments may not be better than available alternatives
	5. Opinions of experts or authorities do not alone provide a reliable basis for deciding on the benefits and harms of treatments
	6. Conflicting interests may result in misleading claims about the effects of treatments
Understanding whether **comparisons** of treatments are fair and reliable	*7. Identifying effects of treatments depends on making comparisons*
	8. Apart from the treatments being compared, the comparison groups need to be similar at the beginning of a comparison (i.e. 'like needs to be compared with like')
	9. If possible, people should not know which of the treatments being compared they are receiving
	10. Small studies in which few outcome events occur are usually not informative and the results may be misleading
	11. The results of single comparisons of treatments can be misleading
Making informed **choices** about treatments	*12. Decisions about treatments should not be based on considering only their benefits*

For an updated overview of all Key Concepts, see: https://www.informedhealthchoices.org/key-concepts/

Figure 1.

Figure 2.

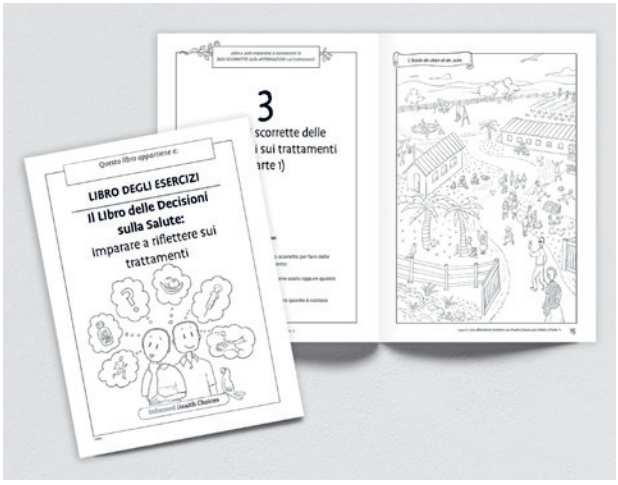

Figure 3.

ment, the inquiries health researchers make to better understand treatment effects, and the considerations individuals should weight when deciding whether to use a health treatment. Additional resources include an exercise book with practical activities for students and a teachers' guide offering more examples, in-depth explanations, and practical advice. These resources were designed to be delivered by teachers over a nine-week period, with one lesson conducted per week.

Another resource developed by the IHC group was the Claim Evaluation Tools. This is a flexible battery of multiple-choice questions that assess an individual's understanding of the IHC Key Concepts and the ability to apply them. The IHC team developed this tool based on feedback from methodological experts, teachers, and the public, and validated it for use by children and adults across high-and low-income countries[10,11].

The IHC learning resources were tested in a cluster randomized trial in 120 schools in Uganda[12], using a set of multiple choices questions corresponding to the 12 Key Concepts taught in the resources (hereafter referred to as the "Claim test"). Findings showed a large positive effect in 10-12 years old students' ability to assess health claims and make informed health choices. A follow-up study showed these skills were retained for at least one year[13].

Since this trial's publication, several teams worldwide have been starting contextualization activities of the IHC learning resources for primary schools in their countries[14-18]. In Italy, after translating the IHC learning resources into Italian in 2019[19], we led a pilot study in 2020 to test the feasibility of introducing the IHC learning resources in two fifth grade classes of a public primary school in Florence (10-11 years-old-students)[20]. Results of this pilot showed that the IHC resources integrated well into the Italian primary school curriculum and were very appreciated both by the teachers and by the students.

To improve the generalizability of this pilot's results, we planned a larger contextualization study, extended to a higher degree of students' ages (9 to 13-years-old) and to various Italian geographic areas[20].

Objectives

The objectives of this study were: 1) to assess the feasibility of introducing the IHC curriculum in Italian primary and lower secondary school; 2) to explore students' and teachers' experiences with the IHC learning resources; 3) to highlight effects, barriers, and facilitators to implementation of the IHC resources in Italian primary and lower secondary school.

Methods

Study design

We employed a convergent mixed method study design to collect, analyse, and interpret both qualitative and quantitative data. All the data were collected in parallel and with multiple approaches and were analysed separately. We integrated data through data-merging and reported results through narrative summaries.

Ethical approval

This study obtained an approval exemption from the Ethics Committee of the Meyer Children's Hospital (Florence, Italy) as no patients, biological specimen or clinical data were involved in the project.

Schools' selection

The previous Italian contextualization project included only 5th grade primary school students. In order to explore use with a wider age group, we included classes from 4th grade primary school to 2nd grade lower secondary school (9 to 13-years-old students) from schools located in Italy teaching in Italian language.

We recruited and collected data during the school year September 2021 to June 2022. After disseminating the IHC project in Italy through the press[21], articles on medical journals[22,23], a science outlet[24], and a webinar[25], and after soliciting interest in a convenience sample of teachers and school principals who were acquaintances of some of this study's authors, we received several requests from primary and lower secondary teachers for more in-depth information about the project.

After giving general information about the IHC project to the interested teachers by email, we asked them if they were willing to participate to a workshop that was preparatory to having their classes undergo the cycle of nine IHC lessons and to participating in this contextualization study.

We then planned three workshops, to be held remotely, in 2021/2022. At the end of each workshop, we asked the teachers whether they would be interested in participating in this study. After expressing their willingness to participate and receiving approval from their class council and school leadership, participating teachers were asked to sign an informed consent (Supplement 1).

The intervention

The intervention included:

- the IHC learning resources
- workshops with the teachers about the IHC Key Concepts and the learning resources.
- the cycle of nine IHC lessons led by the teachers.
- post-lesson student assessment, using the Claim test.

Workshops with the teachers

Teachers interested in participating in this project attended a three-hour online workshop aimed at introducing the IHC Key Concepts and exploring the IHC learning resources.

We shipped the teachers a printed copy of the Italian translation of "The Health Choices Book" and e-mailed them the "Teacher's Guide", as a PDF file. We asked every attending teacher to carefully read both "The Health Choices Book" and "The Teachers' Guide" in preparation for the workshop.

Two of this study's authors tutored the workshops (CA and RR). Each workshop included a limited number of participants to facilitate interactions between the tutors and the teachers. We asked participants to choose the most suitable time and day for the workshop based on their school commitments, and we scheduled the workshops accordingly.

The workshops included an introduction to the course objectives, an introduction to Evidence Based Medicine, a presentation of the IHC project and a session about "The Health Choices Book", in which we went through each of the nine lessons/chapters discussing the IHC Key Concepts included in each lesson. To consolidate the IHC Key Concepts, in addition to the textbook examples, tutors used some extra examples from "The Teachers' Guide" and from the biomedical literature.

Finally, we discussed with the teachers some practical details about the IHC lessons, with the aim of understanding every teacher's school context and available assets (e.g., if they had an interactive whiteboard in the classroom or if they could afford to make copies of the "The Exercise Book" for all the students) and to explain different options of conducting the lessons, based on "The Teachers' Guide" suggestions.

Teachers' recruitment

After the workshops, we e-mailed the attending teachers to ask if they were willing to participate in this study. Interested teachers were then asked to obtain approval from their class councils and school leaderships and to sign informed consents to participate in this study. After receiving signed consents, we e-mailed each participating teacher some materials aimed at collecting feedback about the IHC learning resources and lessons and at supporting group activities (observation forms, teachers' final questionnaire, Claim test questionnaires, and activity cards to be used during the group activity in Lesson 7), and we asked for signed informed consents from all the students' families before the lessons' start.

We requested the participating teachers to use the IHC learning resources in their classes to lead a cycle of nine one-hour lessons during schoolyear 2021-2022; to fill in the observation forms after each lesson; to engage in focused conversations with the students after each lesson and summarize responses in the observation forms; to fill in a final questionnaire after the end of the nine lessons; to administer the Claim test to the students after the end of the nine lessons.

Data collection

To address the study objectives, we used four different ways of collecting students' and teachers' feedback, through both qualitative and quantitative methods (for an overview of which data informed which objective, see table 2).

1. *Teachers' observations after each lesson*: before the lessons' start, we e-mailed participating teachers observation forms. These were modeled on forms provided in the "Guide for Piloting the Informed Health Choices Learning Resources"[26], but we adapted them based on findings from our previous Italian contextualization study findings[20]. During our pilot study, some teachers had autonomously started projects in parallel with the IHC lessons, for example about the developing of a critical approach to advertisements or about creating figurative representations of the Key Concepts through drawings. Therefore, we asked the teachers who participated in the current study to report in the observation forms whether any of the IHC Key Concepts were found useful and transferable to other school subjects or whether the students found the IHC Key Concepts useful in their daily lives.
2. *Focused conversations with the students after each lesson*: teachers led focused conversations with the students after each lesson that included four categories of questions, referred as the "ORID" set of questions[27,28]: Objective (to collect information about the context; Reflective (to identify feelings associated with information); Interpretive (what it means to you); Decisional (what are the next steps). Teachers interviewed the students as a class and collected data in the observation forms through written notes after each lesson.
3. *Teachers' observations at the end of the lessons*: we asked the teachers to fill in a final questionnaire at the end of the nine lessons. Based on the observations made by teachers in the previous contextualization study, we added a question about which Key Concepts were most important according to the teachers' opinion, and whether learning the Key Concepts had in any way changed the teachers' attitude toward health treatments.
4. *Students' answers to the Claim test after the nine lessons*: after the last IHC lesson, teachers asked the students to fill in the Claim test to evaluate their understanding of the 12 Key Concepts and assess health claims to make informed health choices.

Table 2. Contextualization study objectives and data collection.

Study objectives	Data collection			
	Evaluation of the results of Claim Evaluation Tool (Students taught and not taught with the IHC Key-Concepts)	Feedback by the teachers using observation forms	Feedback by the children using observation forms (Teachers notes)	Focused conservation with the children after the lessons (Teachers notes)
Feasibility of introducing IHC curriculum in Italian schools	X	X	X	X
Students' ability to assess heath claims	X	X	X	X
Students' experience with the IHC resources (understandability, desirability, suitability, and usefulness)	X		X	X
Teachers' experience with the IHC resources (understandability, desirability, suitability, and usefulness)		X		
Facilitators and barriers		X	X	X

Data analysis

Quantitative analysis

We analysed the answers to the Claim test from students who had participated in the IHC lessons. We assessed the mean score and standard deviation of the proportion of correct answers at the individual level; the proportion of the students with a passing score (≥13 right answers out of 24); and the proportion of the students with a mastery score (≥20 right answers out of 24). These cut-off scores for passing (having at least a borderline ability to apply the concepts) and mastery (having mastered the concepts) were determined in a previous study[29].

We also aimed to identify the Claim test questions with an error rate exceeding 30%.

Qualitative analysis

We conducted a deductive thematic analysis[30] of the collected data based on the categories previously employed in IHC pilot projects[14-31]: user experience (understandability, desirability, suitability, and usefulness), seriousness of these experiences for the user, teaching method, barriers and facilitators, proposals, and comments.

We organized students' and teachers' qualitative data in two files. Then CA and RR independently coded the data according to the above categories. For each category, all the authors discussed attributions, and dealt with disagreements through discussion.

Finally, we created a narrative summary of the data for each category and explored the range and nature of the phenomena, as well as some possible explanations for the results.

We used the Good Reporting of a Mixed Methods Study (GRAMMS) checklist as a standardized guide for reporting on mixed methods research results[32].

Results

Pre-enrolment workshops and study recruitment

Sixteen teachers requested to participate in the IHC workshops that preceded study enrollment. Two teachers from one school in Emilia Romagna ultimately declined to participate in the workshop, fearing they would be unable to complete the project. They explained that the current complexity of organizing subjects in primary school, rigid schedule and time constraints drove their decision. Fourteen teachers attended one of three workshops with six, three and five attendees respectively.

We held the workshops remotely, via Zoom: two were held in 2021 (September and December), and one was conducted in March 2022. After the workshops, 10 teachers out of the 14 requested to participate in the study and obtained authorization for participating from their respective school boards.

Shortly before lessons' start, two teachers from one school in Lombardy decided, together with their school principal, not to participate in the project, since two families had not authorized participation for their children. The two families had reservations about vaccines and perceived the project to be in conflict with their ideas and expectations. Despite proposing to the school principal to organize a meeting with these parents to discuss that the IHC project does not aim to dictate correct health choices but rather to empower students to make informed choices on their own, the school principal opted to drop the project.

Participants

Eight teachers and 133 students from seven classes at five public schools participated in the study. One school was located in northern Italy (Lombardy), three schools were in the center (two in Tuscany and one in Umbria) and one school was in the south (Campania). Two schools were located in urban context (one in a medium-sized northern Italy city and one in a big-sized central Italy city), one school in a suburban context in southern Italy and two schools were located in rural areas in central Italy.

Four schools were located in mixed socio-economic settings, while one school was situated in a lower socio-economic setting.

One class was 4th grade primary school (18 students, 9 to 10-year-old); three classes were 5th grade primary school (52 students, 10 to 11-year-old); one class was 1st grade lower secondary school (25 students, 11- to 12-year-old); and two classes were 2nd grade lower secondary school (38 students, 12- to 13-year-old).

Teachers led the lessons accordingly to the advised schedule (i.e., nine one-hour lessons, one lesson per week) but, in some cases, lessons were distributed over a longer time period due to Covid-19 outbreaks leading to transient closures of the classes. All participating teachers were female and represented both the humanities and the sciences. Table 3 summarizes the characteristics of the participants, the school contexts, and data feedback for each school.

Quantitative findings: Claim test

Out of 133 students, 72 (54.1%) completed the Claim test. Two classes, including 50 students from one school (school A), did not take the test. Teachers ex-

Table 3. Study participants, school context and data feedback.

								Total
School	School A	School A	School B	School B	School C	School D	School E	5 schools
Region	Lombardy	Lombardy	Umbria	Umbria	Campania	Tuscany	Tuscany	4 regions
Context	Urban	Urban	Rural	Rural	Suburban	Rural	Urban	NA
Class degree	1st degree LSS	2nd degree LSS	4th degree PS	5th degree PS	2nd degree LSS	5th degree PS	5th degree PS	7 classes
Student number	25	25	18	9	13	18	25	133 students
Student age	11-12	12-13	9-10	10-11	12-13	10-11	10-11	9-13
Teachers number	1	1	1	1	1	2	1	8 teachers
Lessons period	January to May 2022	February to May 2022	April to June 2022	April to June 2022	January to April 2022	October to December 2021	November 2021 to March 2022	October 2021-May 2022
CET number	No (0)	No (0)	Yes (10/18)	Yes (9/9)	Yes (12/13)	Yes (18/18)	Yes (23/25)	72/133 CET
Schoolteachers' participatory observations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8/8
Focused conversations with students	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8/8
Teachers' final questionnaire	No	No	Yes	Yes	Yes	Yes	No	5/8

Legend: LSS= Lower Secondary School; PS= Primary School; CET= Claim test.

plained this was due to time constraints resulting from delays in the lessons related to Covid-19 outbreaks.

The mean proportion of right answers to the Claim test was 81.9% (SD 15,1). The proportion of students who achieved a passing score (≥13 correct answers out of 24) was 94.4% (68/72), and the proportion of students who achieved a mastery score (≥20 correct answers out of 24) was 62.5% (45/72). We analyzed the proportion of wrong answers to each question in the Claim test, with three questions out of 24 resulting in more than 30% of the students giving incorrect answers (related to Key Concepts 9 and 11, as listed in table 1). This reflected difficulties in teaching and/or understanding some concepts. For example, the concept of blinding both participants and researchers in the context of a fair comparison was especially difficult for students to understand. Another commonly mistaken concept was about the need to pull together the results of more fair comparisons to be sure that the effect derives from the treatment used and not by the play of chance.

Qualitative findings

Below are summarized results of the qualitative analysis, with more detail in Supplement 2.

Seriousness for the users

Neither the students nor the teachers reported major or minor problems using the lesson material. The teachers proposed some minor changes. For example, with regard to the true/false exercise after Lesson 8, the teachers suggested to rephrase the sentence of the second claim from "a positive effect is an advantage of a treatment" to "a positive effect falls among the advantages of a treatment". This change aims to make it clearer to the students that a positive effect of a health treatment is not synonymous with an advantage of a health treatment, since the latter is a wider category which may include other aspects beyond positive effects (e.g., having to take a medication fewer time a day is an advantage of a treatment, but not a positive effect). Another teacher found Lesson 1 too long and suggested to use the comic format also in this lesson such as in the rest of the book. A teacher proposed to add short videos to the textbook, providing further explanations from a tutor or a character of the textbook. Finally, two teachers would have dedicated more time and space of the textbook to *Kasuku*, the parrot: «Word of mouth in our society is a relevant element to be aware of».

Understandability

The 12 IHC Key Concepts appeared to be generally well understood and clear to the students, both regarding the text («Everyone has their own skin, their own body. It worked well for Sarah, but not for him!») and the illustrations («A child identified in the parrot Kasuku the metaphor for people's attitude of repeating what they have heard without first questioning whether it has a good basis»).

The students interacted with the teachers and with each other, proving to be able to orient themselves both in the context of the story and about the Key Concepts within the story itself («For each claim, you need a basis. The basis is, as you told us, teacher, like the foundation of a house. If the foundation is correct, then the claim is reliable; if the foundation is incorrect, the claim is unreliable»).

Some students required additional time and a few extra examples to grasp the basis of a health claim and to understand the transition from a claim to a research question.

The teachers underlined that the IHC resources helped the students to highlight and expand the understandability of some terms, such as treatment, expert, and choice. For example, some students had some difficulty understanding the meaning of the word 'treatment' not only as a cure but also as a nutritional or surgical intervention. Some other students had difficulty understanding that even not doing something is a treatment, and one student explained the concept to their classmate through their own story («Once I had a bad allergy on my neck, I was all red. I tried many treatments until I found the solution: not being close to pollen»). As for the figure of the "expert" (Lesson 4), two teachers pointed out that some students considered as experts only doctors and health professionals, and they didn't recognize the fisherman or the chef as experts. About the "choice" concept, «It wasn't easy to the children to understand that there isn't a one-size-fits-all right choice, but there is a right choice for each person. There was some disappointment in not finding in the textbook some simple instructions to grasp if a health choice is the right one».

Desirability

The students were engaged in John and Julie's story because they liked the characters and assigned themselves roles and acted it out («The engaging illustrations, the presence of likable characters - such as the funny parrot Kasuku and the peculiar yet amusing events, like the unusual practice of using cow dung to treat burns - made the reading enjoyable and engaging»).

The teachers noticed that students couldn't wait to hear the developing of the story from week to week, because every book's chapter left them in suspense for knowing what would happen («Finally! We've been waiting for a week!»).

Since the first lessons, students paid much attention to the images («During Lesson 2, it was necessary to place the story in space. The children recognized a different setting and expressed curiosity to know more») and the dialogues («They [the professors] are not saying where they will go next time!»). Some teachers noted that the unusual context of the story (an African village) played a crucial role in engaging the students: «I am absolutely convinced that if the story had been set in a context like ours, the children would not have shown the same enthusiasm. It has been a facilitation tool for learning». The teachers emphasized that in all classes, participation and interest in the lessons were not limited to a few students, but almost always included the entire class.

The primary school students loved the group's activities: they even asked the teachers, in more than one occasions, to repeat the activities, but this was generally not possible because of time constraints. As for the secondary school students, one teacher pointed out that students were reluctant to carry out activities involving the use of the body (e.g., putting their hands behind their ears) and that it was therefore necessary to make changes to this activity. Most of the students loved that John and Julie were involved in the professors' research work, and students expressed feeling that they were part of a researchers' team in Lesson 7 activity with the cards.

Suitability

The IHC learning resources were found to be well-suited for conveying specific concepts to students, such as comparison or randomization, through examples that are easily understandable because they draw on real-life situations and are filtered from the perspective of the protagonists of the story, John and Julie. As a teacher annotated, «These lessons allowed the students to ask questions and bring up examples from their daily lives». The teachers highlighted that, despite the unusual setting of the story, the beliefs and customs illustrated in the story share similar aspects across different cultures. This became evident through the many examples raised by students, resembling those presented in the book but situated in their daily lives: «If you score a goal, it's positive! You're happy and full of energy. It's an effect on the mind»; «My brother put some toothpaste on his burn» «Why?» «Because it had happened to my sister as well and she put toothpaste on it and felt better, so she suggested him to do that way»; «Comparing is the

same as testing: hydrogen peroxide or soap against bacteria?».

Regarding the effective/expensive treatments, some students used the example of iPhone 13 and iPhone 10. The teachers emphasized that iPhones are not treatments, and the students highlighted that, in most fields, a more expensive item is not necessarily more effective.

One teacher observed that the story setting, geographically far away from Italy, «moves away the students from regionalism and highlights the pervasiveness of some beliefs». There were also some cultural differences the students noticed in the story: for example, a discussion took place about John and Julies' autonomy, because the students were surprised that they could go to the clinic on their own and discuss health treatments with the professors without their parents. Some students' observations showed that students could engage in a problem-solving process by considering facts from various perspectives: «Having stronger muscles isn't always a positive effect, because those who engage in bodybuilding might take steroids to achieve this result, damaging their health».

Usefulness

The students learned to use the IHC Key Concepts not only to improve their critical approach to health claims and treatments, but also beyond health science: «They really liked the drawing of John and Julie's school, which is very different from our school which has fewer spaces and a lack of greenery». One teacher annotated that the search of the claim basis was constantly present in their discussions: «The teacher asks: "Why do you think it was an unfair comparison?" "Because the group 1 always wins: they are closer to the blackboard! The two groups should have been at the same distance from the blackboard, or we are making an unfair comparison!"»; «What changes if it costs more? Just because it costs more doesn't mean it's better!».

Most of the teachers noticed how the Key Concepts' learning stimulated the students to refine their complex thinking: «Water is good for you, but if you drink too much of it all at once and it's very cold, you might get a stomach-ache»; «On my mom, the vaccine had a negative effect because the day after [she got it], she felt really unwell and couldn't come to dinner, but it had also a positive effect because if she had caught Covid, she would have been safe». One teacher wrote the class got involved in a discussion about a character of the textbook, Ruth, wearing a veil: «Is Ruth a nun? Will she be killed if she takes it off?».

The learning of Key Concepts also sparked a discussion about the figure of "expert" and the "influencer". In the first case, most students were surprised to realize that even their teachers could make unreliable claims or mistakes, emphasizing that the basis of a claim is more important than the person making it. In the second case, they learned that a claim is not more reliable simply because a famous person, even their favourite singer or player, made it.

Value of IHC resources

The IHC resources were found to be comprehensible, engaging, suitable for the Italian school context, and valuable for the development of critical thinking about claims and treatments, and beyond the health science domain.

Most teachers emphasized how the structure of the lessons allowed for the unanimous participation of the entire class. The participation is intended as an interaction between teachers and students as well as an interaction between students themselves. This was observed in all classes, regardless of the students' vulnerabilities or disabilities: «The project was conducted in a 5th-grade class that includes three students with physical disabilities, three students with learning disabilities, and two students with family-related issues; no difficulties were highlighted, and all children were equally involved. Balanced groups were formed for collective activities».

All teachers also pointed out how the geographically distant context of the story stimulated discussions on similarities and differences, both in health science and other areas (architecture, cuisine, clothing, children's, and adolescents' autonomy). The exercises and activities were described by the teachers and the students as understandable and engaging. Some teachers reported that the exercises were challenging for students at first but progressively became easier. Other teachers reported that activities' instructions in "The Health Choices Book" (e.g., Lesson 7) was not immediately clear and required discussion among teachers. One teacher pointed out that the activities were useful for the entire class, and, in some cases, they were especially useful for students with mild cognitive disabilities, because they enabled the students to become more familiar with and have direct experience with new concepts.

Barriers and facilitations

In our analysis, the main barrier to the implementation of the IHC curriculum were found to be related within the Covid-19 restrictions: absences of teachers and students and occasional remote learning lessons, all due to the pandemic situation in 2021-2022. In a few cases, the teachers overcame the restrictions by transforming group activities into individual ac-

tivities. Others have reported time constraints: for example, the project took longer than planned because of the Covid-19 related absences. Additionally, during periods of remote learning, some activities were considered not to be feasible due to logistic difficulties (eg, group activities). As a result, the IHC lessons were temporarily stopped during remote learning and resumed when students and teachers were back in class. A secondary school teacher mentioned time constraints not only related to Covid but also to the duration of the project's modules: «Each module takes too much time and in order to be better applied in a second-grade secondary school, some activities would need to be optional».

Most teachers highlighted that many facilitations and incentives were embedded in the IHC learning resources and in the teaching model. The multicultural context of the story, the realistic experiences of the characters, and the easy analogies between the characters' experiences and the students' experiences were reported as incentives. Another unanimously reported facilitation was the inclusiveness of the whole class in the IHC lessons, attributed by the teachers to the structure of the lessons, both highly interactive and based on problem-solving processes. The presence of more than one teacher during the lesson was also mentioned as a facilitation, occurring at the primary but not at the secondary school level. Three teachers underlined the exchanges of information and clarifications with the researchers supporting the project was a facilitation.

Compatibility with the Italian school curriculum and with the teachers teaching style

All teachers reported more than one link between the concepts of the IHC curriculum and the Italian school curriculum, particularly in the subjects of science, civic education, mathematics and statistics, physical education, and Italian language. Figure 4 illustrates not only the excellent alignment of the IHC curriculum with the Italian primary and secondary school curriculum, but also the numerous connections and applications of the IHC Key Concepts in science and beyond science-related subjects. The IHC Key Concepts covered multiple scientific topics in Italian school curriculum, such as health science (e.g., the human body), scientific method (Galileo Galilei, experimental method, fair comparisons) and statistical principles (randomization, large numbers, data collection, analysis, and interpretation).

All the teachers reported a high compatibility between the IHC resources and lessons and their usual teaching style and school context: in particular, they liked the use of key words, repetition of concepts, high interactivity, role play, discussions in small or large groups, practical activities.

The resources and lessons were found to be highly versatile and adaptable to specific school contexts: teachers from humanities as well as scientific area held the IHC lessons, small changes in activities due to the pandemic or class context had been feasible, and in terms of usability the students read aloud the comic, while in other cases, the teachers read aloud the comic to the class.

Examples of critical thinking skills stimulated by the IHC curriculum

Recognition of authority bias

From the qualitative analysis, interesting reflections emerged from students who, guided by the teachers, discussed the concept of authority bias. This involved the importance of evaluating health claims based on

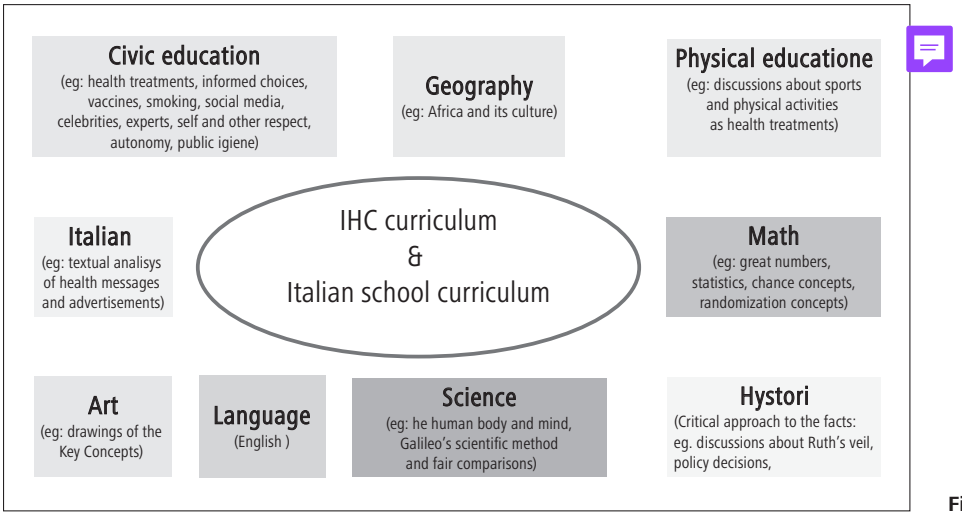

Figure 4.

the reliability of their foundation rather than on the expertise or fame of the persons making the claims. Introducing this critical tool early is crucial, considering that experts or famous individuals are often perceived as highly credible sources for health-related claims. As one teacher emphasized, «the more the claim comes from a famous or admired person, the more difficult it is to doubt it».

The right choice for every person

Another content that emerged through the IHC resources was the students' difficulty in understanding that often in healthcare there is not a right choice for everyone, but only the right choice for each person. Faced with the situation described in Lesson 8, where John and Julie have to decide whether to take antibiotics for an ear infection, the students expected a unique and certain solution, like a rule or precept that could be applied to both children. Instead, they were surprised to read that John's choice (to take antibiotics) could be opposed to Julie's choice (not to take antibiotics) and that both could be right. The treatment of ear infections is a suitable example because there is no single effective treatment for ear infections. In fact, studies have shown the effectiveness of various treatments, such as not taking any treatment, taking antibiotics, or taking painkillers. The choice is based on both the individual's personal risk and the severity of symptoms. This data aligns with one of the most frequently missed questions in "The Exercise Book", which asserted that doing nothing is also a treatment – a statement that most students in different classes considered false, even though it is true. This students' difficulty underscores an idea of medicine and care that is still too tied to a biomedical model, rigidly applying the relationship between a disease and a cure. This model is challenging to apply in a complex and variable context like human health and disease: each person may have a health problem that manifests differently; at the same time, each treatment may have benefits and adverse effects that can vary from person to person. The example from Lesson 8 conveys this complexity to students.

Autonomy of children

Another aspect highlighted by students was their wonder about the autonomy of John and Julie in the story: the children autonomously discuss health science topics with the professors, go alone to the village clinic, and independently arrive at understanding the process of an informed health choice that concerns themselves (whether to take antibiotics for an ear infection), even though the professors encourage the children to discuss their decisions with parents, the ultimate decision-makers for minors' health decisions. These situations stimulated discussion among students about the decision-making autonomy of minors, a concept still neglected at the social, cultural, and political levels. Despite the International Convention on the Rights of the Child and Adolescence[33] establishing the fundamental principle of children's right to be heard and intervene in decision-making processes that concern them, very little or no weight has been given to children's voices in the recent pandemic period regarding crucial decisions that affected them. For example, Italy was one of the countries that kept schools closed for more days than any other European countries[34].

Discussion

The results of our analysis indicate that the IHC curriculum is very well aligned with the Italian curriculum, and that both students' and teachers' experiences with the resources were positive.

Teachers unanimously reported that students' engagement in the lessons was not limited to a small group, but included the whole class, even in classes with a substantial number of students with vulnerabilities (e.g., health problems or disabilities). Qualitative feedback indicated that students demonstrated overall a very good understandability of the IHC Key Concepts, a finding that is consistent with the Claim test scores obtained by the students at the end of the lessons.

Qualitative data showed that the students used the Key Concepts in different contexts, such as health choices, but also in peer-to-peer interactions, critical evaluation of advertising messages, history, sports, statistical thinking etc.

We identified several factors that appeared to facilitate teaching and learning. Some were related to the teachers (e.g., application of the IHC Key Concepts to Italian traditional school curriculum subjects, such as Math or Art); some to the students (e.g., ability to adapt the IHC Key Concepts to everyday life), and some to the IHC learning resources, such as the geographical and cultural setting of "The Health Choices Book" differing from the Italian setting and thereby stimulating students' curiosity.

The main barriers identified were related to the pandemic (e.g., time constraints, logistic difficulties). While the teachers adapted the educational resources to the overall context and to the classroom context (e.g., by transforming some group activities suggested by the textbook into individual activities), the school system did not seem as flexible as the school staff. In fact, Italian educational policy failed to adapt to the changing

context and was unable to promote the school continuity of students. For example, during the pandemic period, school closures in Italy amounted to 314 days, compared to a European average of 138 days[34].

Comparison with other studies

This is the second contextualization study of the IHC learning resources that has been conducted in Italy. The two Italian contextualization studies design differ significantly. The first study[20] was carried out in two 5th-grade classes of a single urban primary school in an intermediate socio-economic context, involving 46 participating students and two teachers who were physicians, trained in Evidence-Based Medicine and familiar with the IHC learning resources (they also had translated the resources into Italian). The current study involved a larger number of students, more classes, and more schools, with various geographical distribution and socio-economic context as well as a broader age range. Furthermore, in the first study two physicians (who were also the study researchers) taught the lessons; in this study lessons were taught by the children's regular teachers after they received training in a 3-hour teacher workshop. These changes from the first study to the current study design provide greater generalizability of this study's results to the Italian school context and suggest the feasibility of implementing the project on a wider scale.

Despite the significant difference between the studies' designs, the results are similar (table 4). Slightly different quantitative results were observed in the first contextualization study and in the current study, whereas students in the first study reached higher rates of passing and mastery scores at the Claim test. These differences may be explained by the play of chance but also by the more "ideal" design of the first study versus the more "real world" design of the current study. Moreover, the first study had a "pre-post" design, so students answered the questionnaire both in the beginning of the study and again at the end. This may have resulted in them producing more correct answers the second time.

Our study design is similar to the IHC pilot study that was conducted in Barcelona[14]: both are mixed-methods studies, conducted using the same IHC learning resources in a cycle of nine weekly lessons, each lasting one hour, and led by teachers from the involved schools after training in a half-day workshop. The scale of the two studies is also comparable: the Barcelona study, in fact, recruited 143 children from the 4th and 5th grades of primary school, gathered in six classes, and involved six teachers. Moreover, these two studies were both conducted in Southern Europe and in high income countries, members of the European Union. The similarity between these two studies' findings underlines and strengthens the generalizability of both studies' results.

Another comparison can be drawn with the cluster randomized controlled study which was conducted in Uganda[12]: in this study the IHC learning resources were used in a cycle of nine 80-minute lessons, with teachers who had been trained through workshops. Outcomes were assessed through the results of the Claim test administered to the students at the end of the lessons.

What emerges from the comparison between our study and the Ugandan trial is that, despite the remarkable results observed in the latter favoring the intervention group, childrens' scores were lower when compared to those of the studies conducted in Italy and Barcelona. Several factors may contribute to explain these differences, including the different studies' design (the Ugandan study is a randomized controlled trial), the significant disparity in sample sizes among these studies, the social, cultural, and economic challenges of sub-Saharan Africa countries compared to Europe, as well as logistical and organizational differences (e.g., larger class sizes and a lower teacher-to-student ratio in the African context). The cultural starting point may have also

Table 4. Comparative Quantitative Analysis from this study and other studies.

	This study	Barcelona Study[13]	Florence Pilot[16] project	Ugandan RCT[11]
Mean Proportion of right answers to the CET and Standard Deviations	81.97% SD= 15,1	NA	89.2% SD= 9.4	62.4% SD= 18.8
Passing Score (≥13 right answers to CET out of 24)	94.4%	97.3%	100%	69%
Mastery score (≥20 right answers to CET out of 24)	62.5%	62.2%	82,5%	19%

Legend: NA= Not Applicable; CET= Claim test; SD= Standard deviation; RCT= Randomized controlled trial.

played a role in this difference. For instance, in the Ugandan study, the beneficial effects of the intervention were found to be larger for children with better reading skills.

Limitations and strengths

Our study has limitations. First, the choice of a selected sample of voluntary teachers may have favored the inclusion of highly motivated participants. This may have contributed to the overall favorable outcome. Second, the sample of students/schools was limited, likely due to challenging recruitment of teachers/schools during the pandemic. We included five schools, although our initial target was to include at least 10, aiming for a more representative participation from various Italian regions. Nevertheless, we collected extensive qualitative and quantitative data on participants' experiences, which remained consistent in mixed analyses, enhancing the credibility of findings. Additionally, the similarity of results with both the previous study conducted in Italy and the similar study conducted in Spain further emphasize the credibility and generalizability of these results.

Third, the group of students who attended the IHC lessons and filled in the Claim test after the end of the lessons' cycle was not compared with a control group (students who filled in the Claim test without attending the IHC lessons). Since the basic knowledge of Key Concepts by Italian students is not known, it is possible that the quantitative results are overestimated. On the other hand, the IHC Key Concepts are not part of the traditional Italian school curriculum and critical health literacy levels found in the Italian population during the pandemic period were largely insufficient or problematic[35]. Therefore, it is possible that our Claim test scores reflect at least partly the learning of the IHC Key Concepts from the students rather than an upstream skill.

A notable strength of this study lies in the consistency of feedback gathered from diverse sources and collected through various methods. The results of qualitative and quantitative analyses both illustrate the feasibility of implementing the IHC learning resources in primary and lower secondary schools across Italy. For instance, the quantitative analysis of the most frequently incorrect Claim test answers aligned with the observations reported by teachers in the observation forms. Moreover, the qualitative data concerning barriers, such as time restraints due to the parallel traditional curriculum workload and, more significantly, to the Covid-19 pandemic, coincided with the absence of some quantitative data, i.e., the non-completion of the Claim test in two classes.

Guidance for using the IHC resources in Italian primary and secondary school

Based on this study's findings[31], we agreed on the following guidance (table 5):

1. A meeting with the school principal and teachers should be organized to present the project to parents, addressing any potential questions before seeking authorization for student participation.
2. Teachers are encouraged to adapt the IHC teaching materials to their specific context, including class, school, school subjects, availability, and time constraints.
3. In case some students have difficulty understanding certain Key Concepts, it is important for teachers to dedicate extra time to explaining them, identifying alternative strategies (e.g., using extra examples from daily life) to facilitate their understanding.
4. During the lesson period, project coordinators should be available to provide prompt support to teachers in case any question or issue arises.
5. To effectively explain the Key Concepts to students, teachers should utilize IHC resources and prioritize interactive, problem-solving based teaching method.
6. Integrating the IHC Key Concepts across the subjects of the Italian school curriculum is possible and desirable, as it allows students to develop critical thinking skills in a broader educational context.
7. Connecting the IHC Key Concepts to real-life situations is both possible and desirable, enabling students to apply critical thinking skills beyond the classroom.
8. The duration of the project can be a factor hindering its implementation when time constraints or logistic difficulties are present (as was the case during the Covid-19 pandemic period).

Conclusions

The increasing willingness of individuals to take an active role in health decisions contrasts with the inadequate health literacy of the European population. Through the contextualization of IHC learning resources in Italy, we observed that IHC Key Concepts of critical thinking not only helped students to understand and assess health claims and treatments, but also to make informed choices, also beyond health. This approach provides one highly feasible solution to needs highlighted by health literacy research.

Conflict of interests: the authors have no conflict of interests to declare.

Table 5. Guidance for using the IHC resources in Italian primary and secondary schools.

Findings	Importance of the findings[31]	Recommendations
«Shortly before lessons' start, two teachers [..] decided, together with their school principal, not to participate in the project, since two families had not authorized participation for their children. The two families had reservations about vaccines and perceived the project to conflict with their ideas and expectations».	Very important negative finding	1. A meeting with the school principal and teachers should be organized to present the project to parents, addressing any potential questions before seeking authorization for student participation.
The teachers adapted the educational resources to the overall context, to the classroom context, to Italian school curriculum and to students' everyday life.	Very important positive finding	2. Teachers are encouraged to adapt the IHC teaching materials to their specific context, including class, school, school subjects, availability, and time constraints.
Some Key concepts were difficult for the students to understand.	Very important constructive finding	3. In case some students have difficulty understanding certain key concepts, it is important for teachers to dedicate extra time to explaining them, identifying alternative strategies (e.g., using extra examples from daily life) to facilitate their understanding.
«Three teachers underlined the exchanges of information and clarifications with the researchers supporting the project was a facilitation».	Very important positive finding	4. During the lesson period, project coordinators should be available to provide prompt support to teachers in case any question or issue arises.
Most teachers highlighted that many facilitations and incentives were embedded in the IHC resources and in the interactive and problem-solving teaching model, which involved the whole class in the lessons, regardless of context specificities and vulnerabilities.	Very important positive finding	5. To effectively explain the Key Concepts to students, teachers should utilize IHC resources and prioritize interactive, problem-solving based teaching method.
All teachers reported more than one link between the concepts of the IHC curriculum and the Italian school curriculum, particularly in the subjects of science, civic education, mathematics and statistics, physical education, Italian language.	Very important positive finding	6. Integrating the IHC Key Concepts across the subjects of the Italian school curriculum is possible and desirable, as it allows students to develop critical thinking skills in a broader educational context.
The IHC lessons allowed the students to ask questions and bring up examples about their daily life.	Very important positive finding	7. Connecting the IHC Key Concepts to real-life situations is both possible and desirable, enabling students to apply critical thinking skills beyond the classroom.
Two teachers declined to participate in the project and explained that the current complexity of organizing subjects in primary school, rigid schedule and time constraints drove their decision. Two entire classes, including 50 students from one school (school A), did not take the test. Teachers explained this was due to time constraints resulting from delays in the lessons related to Covid-19 outbreaks.	Very important negative finding	8. The duration of the project can be a factor hindering its implementation when time constraints are present (as was the case during the Covid-19 pandemic period).

"Importance of the finding" code descriptions:
- Very important negative finding A problem that we should address for the resources to be effective.
- Important negative finding A problem that we should probably address for part of the resources to be effective.
- Negative finding A problem that we can easily address and probably will not prevent the resources
- from being effective.
- Very important positive finding Praise that probably should inspire changes.
- Important positive finding Praise that maybe should inspire changes.
- Positive finding Praise that probably should not inspire changes.
- Very important constructive finding A suggestion that probably should inspire changes.
- Important constructive finding A suggestion that maybe should inspire changes.
- Constructive finding A suggestion that probably should not inspire changes.

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