POSTER DESIGN

Formal and Informal Science Communication

CRASC - 20/04/26

ADITIONALRESOURCES

Mike Morrison: How to create a better research poster in less time (#betterposter Generation 2)

Mike Morrison: What do people look at on your research poster?

Miha Maček

- Graphic designer and photographer.
- Design experiences: from Jan Plestenjak to Elan Motor Yachts and a lot of interesting projects in between.
- Photography experiences: from National Geographic Junior to Cosmopolitan and a diverse array of projects in between.

Target audience

General questions:

A. Age
B. Sex
C. Education level
D. Income
D. Place of living
E. Employment

EXERCISE 1

Identify and specify the demographic characteristics of the intended audience for the posters used as examples.

Additional questions because of very specialised target audience:

1. Level of technicality vs. general presentation?
2. Is the poster intended to be viewed with the author present, or independently?

Developing new habits for Physics teachers through Creative Ateliers

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INTRODUCTION

Recent research in Physics Education shows teachers worldwide how a modernization of techniques and strategies is necessary. Many different approaches and models are being employed to transmit content to our students, and all present the same challenge: instructing teachers to utilize them effectively and making them the habitual choice.

A Creative Atelier is a pedagogical environment where creativity is used to scaffold learning processes. They are mainly used to help children learn and were born in Reggio Emilia's preschools [1].

Expanding the Reggio Emilia experience with Creative Ateliers to in-service Physics teachers, we organized a course called "Creative Atelier for Physics Exercises and Problems" to provide our participants with new tools for in-class teaching.

We embraced the theoretical framework for teachers' training programs DHAC (Development of Habits through Apprenticeship in a Community) [2] to develop a training course based on the concept of the Creative Atelier.

We built the contents and materials of our course looking at the ISLE (Investigative Science Learning Enviroment) framework, particularly the use of non-traditional problems and exercises, the definition of scientific abilities and the use of rubrics for assessment [3, 4, 5].

OBJECTIVES

review the Italian and European requirements and recommendations to Physics high school teachers on competencies and scientific skills development

compare these requests with the scientific abilities defined by the ISLE approach

→ build a correspondence between the two

organize a teacher training program →

- provide our teachers with new tools to develop and assess scientific abilities
- help Physics teachers developing new productive habits to employ in their teaching practice

the two habits we focused on developing are:

USING NEW NON-TRADITIONAL TYPES OF PROBLEMS AND EXERCISES (ISLE-based)

USING FORMATIVE ASSESSMENT IN THE EVALUATION PROCESS

METHODS

THE COURSE:

The Creative Atelier took place in Trieste, Italy and it was hosted by the Physics Department of University of Trieste.

All the materials created for (and during) the program are immediatly available in Italian. Translated materials will be distributed to anybody interested.

- Hybrid mode: both in-presence and online.
- Thirty nine attendees, some teachers, some students.
- Five meetings, 3 hours long (15 hours total).
- Between November 2023 and January 2024.
- Two non-traditional problem types each meeting.
- Group work for every problem type, after having viewed and discussed multiple examples:

Distribution of the location of the Atelier's participants.

start with a traditional problem, taken from an Italian high school textbook

solve the starting problem and identify useful information

build the new, non-traditional problem with the characteristics of the chosen type

give the problem to a different group, that solves it

share observations with everyone

finalize the problem's construction

to help our teachers develop new productive habits we aimed to change their

DISPOSITIONS	SKILLS	KNOWLEDGE
Recognize non-traditional problems as useful tools to develop scientific abilities. See the necessity of formative assessment.	Convert old types into the new ones, build and use the new ten problem types and how to evaluate a solution using rubrics.	Know new types of problems and exercises in the ISLE-framework design and approach. Know which scientific abilities these problems activate.

DATA COLLECTED:

QUANTITATIVE	QUALITATIVE
Exercises and problems produced during the Creative Atelier: 24 problems of different types Responses to a final evaluation questionnaire	Observations and comments made by the attendees during the meetings, transcripted using video recorded ateliers.

The material is not reported here because it is in Italian.

To find out more, CONTACT US!

THEORETICAL FRAMEWORK

DHAC [2, 4]
Development of Habits though Apprenticeship in a Community

a teacher's habits have their roots in

DISPOSITIONS	SKILLS	KNOWLEDGE
are one's beliefs and attitudes related to some aspects of teaching.	relate to techincal and emotional abilities that a teacher needs to lead a lesson.	of what to notice, how to act, which behaviours to stop and which to encourage.

to develop new habits, a teacher's training program has to include

a. Practice-based apprenticeship: the attendees need to observe reformed teaching practice and then slowly start taking part in it. Instructors have to guide the attendees and provide rapid feedback, before gradually assigning more independent work.

b. Coursework on the learning and teaching of Physics: knowledge of subject-specific content is not enough for a teacher. A teacher training program needs to focus on the learning process, topic-specific and general tools and tasks.

c. Care and feeding of a community of physics teachers.

ISLE scientific abilities and non-traditional Problems and Excercises [3]

SCIENTIFIC ABILITIES

1. Multiple representation
2. Devise and test and explanation (or relationship)
3. Account for anomalous data
4. Design an experiment
5. Record, represent and analyze data
6. Evaluate predictions, claims and models
7. Communicate assessed using rubrics.

non-traditional PROBLEMS

1. Ranking task
2. Choose answer and explanation
3. Choose measuring procedure
4. Evaluate
5. Make judgment based on data
6. Linearization
7. Multiple possibility and tell all
8. Jeopardy
9. Design an experiment (or pose a problem)
10. Problem based on real data

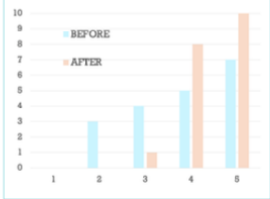
We followed Šarlah and Planinšič's paper "*Designing new types of problems using peer-reviewed papers*" to transform traditional problems in new ones. The process we used is:

Solve the original exercise → **Deconstruct** the solution → **Build** the new problem → **Solve it** → ask for **feedback**

PRACTICE-BASED APPRENTICESHIP
COURSEWORK ON THE LEARNING PROCESS
COMMUNITY OF TEACHERS
to change →
DISPOSITIONS
KNOWLEDGE
SKILLS
to develop →
NEW PRODUCTIVE HABITS

FINDINGS AND CONCLUSIONS

Value given to scientific abilities and their assessment BEFORE and AFTER participating in the Atelier:
(1-very little; 5-a lot)



Interest demonstrated to the different types of non traditional problems:

When we [teachers] prepare tests, we often look for, as the students say, the exercises "with more stars", i.e. more difficult ones. Perhaps that's because we think that the more complex ones can show us how much and what a student has understood. I now realize that even the simpler ones, for example some of the types we have seen, can make the student reflect and identify the conceptual knots.

Observation made by a high-school teacher after having participated in the Creative Atelier, translated from Italian.

- Both ISLE experts and newcomers appreciated the Creative Atelier experience.
- We uncovered that almost half of the teachers don't habitually use tools to assess scientific abilities.
- We detected a raise in the value given to scientific abilities and their assessment.
- All attendees actively took part in the creative activities. This strengthened our community of Physics teachers and students interested in Physics Education.
- The responses to the questionnaire revealed willingness to question traditional methods and embrace new habits.
- The proposed innovative tools have been appreciated and meet the needs of the teachers who participated.

Acknowledgements
We thank Eugenia Etkina and Gorazd Planinšič for their support, the Department of Physics of the University of Trieste for hosting the Creative Atelier and other PE-related activities, the National Program for Scientific Degree (PLS, Piano Lauree scientifiche) and the CARIGO Foundation.
We send a thought to Alan Van Heuvelen, recently left away, who dedicated his life to Physics Education research and has had an enormous impact on ISLE's growth.

References:

[1] L. Gandini et al. (2005), *In the Spirit of the Studio: Learning from the Atelier of Reggio Emilia* (Early Childhood Education Series). Teachers College Press.
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access the articles:

Target audience

General questions:

A. Age
B. Sex
C. Education level
D. Income
D. Place of living
E. Employment

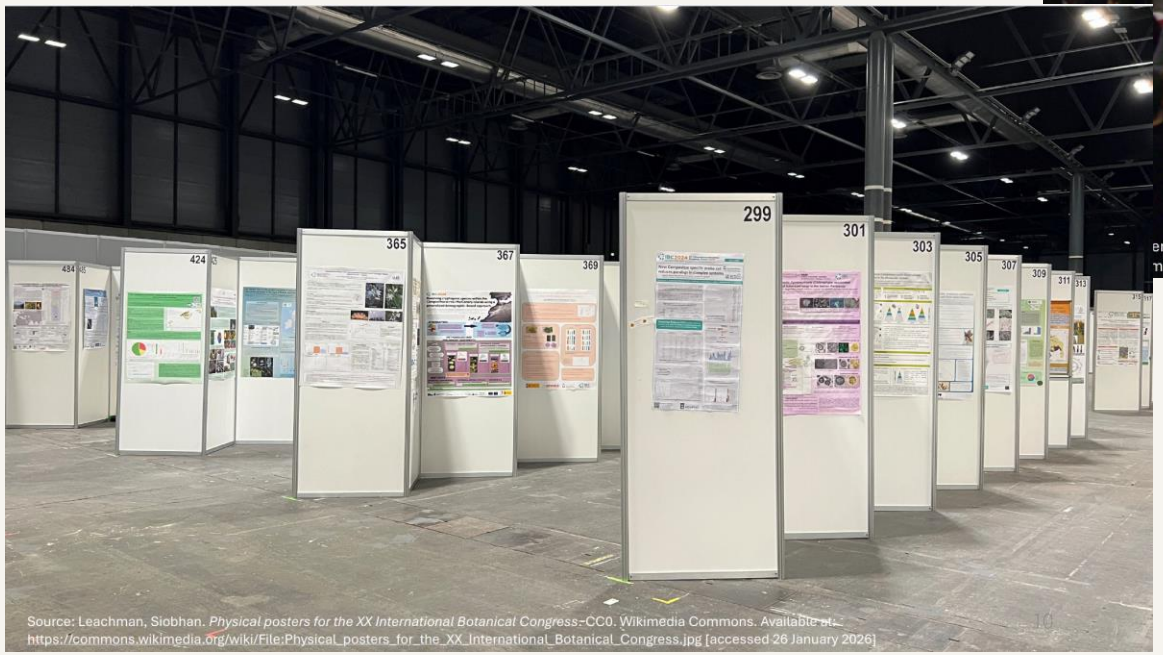
EXERCISE 2

How much time does an average conference participant spend absorbing the essence of a poster?
One minute? More or less?

- LOOK THE POSTER FOR ONE MINUTE, THEN WRITE ALL THE THINGS YOU REMEMBER, THEN FOR TWO ….

What happens in reality?

erman-Chase, Tim. *[ICCV 2011 Poster Session, Barcelona]*. CC BY 2.0. Wikimedia Commons. Available at: mons.wikimedia.org/wiki/File:ICCV_2011_Poster_Session,_Barcelona.jpg [accessed 26 January 2026].



Source: Leachman, Siobhan. *Physical posters for the XX International Botanical Congress*-CC0. Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/File:Physical_posters_for_the_XX_International_Botanical_Congress.jpg [accessed 26 January 2026]

TARGET AUDIENCE

A conference attendee must be able to grasp the core **essence of the poster within one minute.**

Any additional information should be regarded as a secondary layer, to be explored subsequently through dialogue, further reading of the published paper, or other forms of academic communication.

TARGET AUDIENCE

The poster author acts as a "**classic advertiser**" – the goal is to "sell" knowledge effectively.

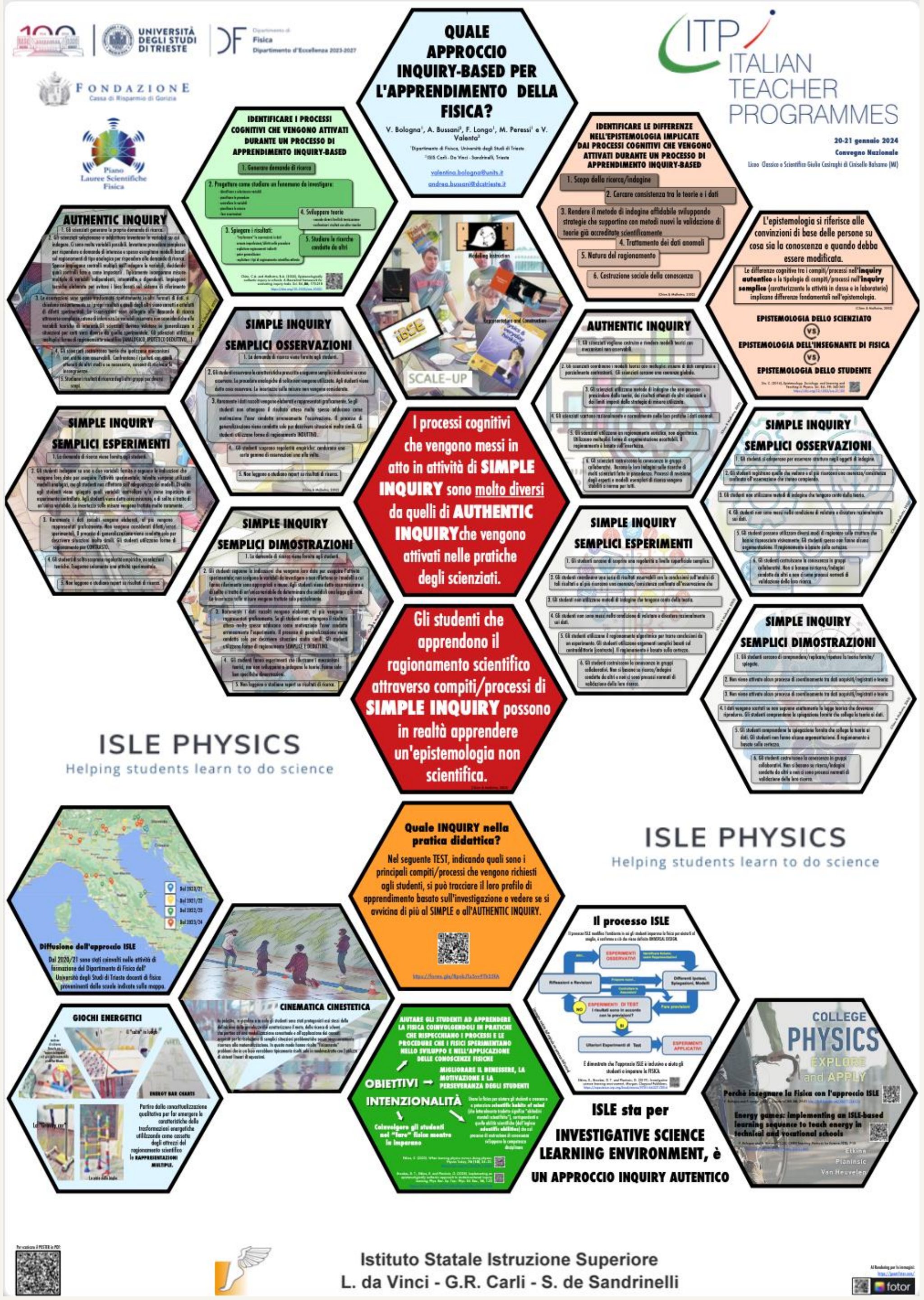
A researcher must compete for attention in a crowded conference hall.

As "classic advertisers," researchers know that the whole story cannot be told at once; in most cases they must first hook the viewer with a clear, compelling value proposition.

The "product" (knowledge) is the new insight or data.

EXERCISE 3

I will present two research posters for review. After a one-minute observation period, you will provide a summary of the key findings you identified.


UNIVERSITÀ DEGLI STUDI DI TRIESTE
Dipartimento di Fisica
Dipartimento d'Eccellenza 2023-2027
FONDAZIONE Cassa di Risparmio di Gorizia
Piano Lauree Scientifiche Fisica
QUALE APPROCCIO INQUIRY-BASED PER L'APPRENDIMENTO DELLA FISICA?
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ITP ITALIAN TEACHER PROGRAMMES
20-21 gennaio 2024
Convegno Nazionale
Liceo Classico e Scientifico Giulio Casiraghi di Cinisello Balsamo (MI)
IDENTIFICARE I PROCESSI COGNITIVI CHE VENGONO ATTIVATI DURANTE UN PROCESSO DI APPRENDIMENTO INQUIRY-BASED
1. Generare domande di ricerca
2. Progettare come studiare un fenomeno da investigare:
3. Spiegare i risultati:
4. Sviluppare teorie
5. Studiare le ricerche condotte da altri
IDENTIFICARE LE DIFFERENZE NELL'EPISTEMOLOGIA IMPLICATE DAI PROCESSI COGNITIVI CHE VENGONO ATTIVATI DURANTE UN PROCESSO DI APPRENDIMENTO INQUIRY-BASED
1. Scopo della ricerca/indagine
2. Cercare consistenza tra le teorie e i dati
3. Rendere il metodo di indagine affidabile sviluppando strategie che supportino con metodi nuovi la validazione di teorie già accreditate scientificamente
4. Trattamento dei dati anomali
5. Natura del ragionamento
6. Costruzione sociale della conoscenza
L'epistemologia si riferisce alle convinzioni di base delle persone su cosa sia la conoscenza e quando debba essere modificata.
EPISTEMOLOGIA DELLO SCIENZIATO
VS
EPISTEMOLOGIA DELL'INSEGNANTE DI FISICA
VS
EPISTEMOLOGIA DELLO STUDENTE
AUTHENTIC INQUIRY
1. Gli scienziati generano le proprie domande di ricerca.
SIMPLE INQUIRY
SEMPLICI OSSERVAZIONI
1. La domanda di ricerca viene fornita agli studenti.
5. Non leggono o studiano report su risultati di ricerca.
SIMPLE INQUIRY
SEMPLICI ESPERIMENTI
1. La domanda di ricerca viene fornita agli studenti.
SIMPLE INQUIRY
SEMPLICI DIMOSTRAZIONI
Modelling Instruction
SCALE-UP
I processi cognitivi che vengono messi in atto in attività di SIMPLE INQUIRY sono molto diversi da quelli di AUTHENTIC INQUIRY che vengono attivati nelle pratiche degli scienziati.
Gli studenti che apprendono il ragionamento scientifico attraverso compiti/processi di SIMPLE INQUIRY possono in realtà apprendere un'epistemologia non scientifica.
ISLE PHYSICS
Helping students learn to do science
Quale INQUIRY nella pratica didattica?
Nel seguente TEST, indicando quali sono i principali compiti/processi che vengono richiesti agli studenti, si può tracciare il loro profilo di apprendimento basato sull'investigazione e vedere se si avvicina di più al SIMPLE o all'AUTHENTIC INQUIRY.
Diffusione dell'approccio ISLE
Dal 2020/21 sono stati coinvolti nelle attività di formazione del Dipartimento di Fisica dell' Università degli Studi di Trieste docenti di fisica provenienti dalle scuole indicate sulla mappa.
CINEMATICA CINESTETICA
GIOCHI ENERGETICI
ENERGY BAR CHARTS
Partire dalla concettualizzazione qualitativa per far emergere le caratteristiche delle trasformazioni energetiche utilizzando come cassetta degli attrezzi del ragionamento scientifico le RAPPRESENTAZIONI MULTIPLE.
AIUTARE GLI STUDENTI AD APPRENDERE LA FISICA COINVOLGENDOLI IN PRATICHE CHE RISPECCHIANO I PROCESSI E LE PROCEDURE CHE I FISICI SPERIMENTANO NELLO SVILUPPO E NELL'APPLICAZIONE DELLE CONOSCENZE FISICHE
OBIETTIVI
MIGLIORARE IL BENESSERE, LA MOTIVAZIONE E LA PERSEVERANZA DEGLI STUDENTI
INTENZIONALITÀ
Coinvolgere gli studenti nel "fare" fisica mentre la imparano
Il processo ISLE
ESPERIMENTI OSSERVATIVI
Riflessioni e Revisioni
Differenti Ipotesi, Spiegazioni, Modelli
ESPERIMENTI DI TEST
I risultati sono in accordo con le previsioni?
NO
SI
Fare previsioni
Ulteriori Esperimenti di Test
ESPERIMENTI APPLICATIVI
È dimostrato che l'approccio ISLE è inclusivo e aiuta gli studenti a imparare la FISICA.
ISLE sta per
INVESTIGATIVE SCIENCE LEARNING ENVIRONMENT, è
UN APPROCCIO INQUIRY AUTENTICO
COLLEGE PHYSICS
EXPLORE and APPLY
Perchè insegnare la Fisica con l'approccio ISLE
Energy games: implementing an ISLE-based learning sequence to teach energy in technical and vocational schools
Etkina
Planinsic
Van Heuvelen
Istituto Statale Istruzione Superiore
L. da Vinci - G.R. Carli - S. de Sandrinelli

Monitoring the wave phenomena learning process through Bayesian updating activities

Students show a marked deficit in meta-cognitive control [1-4].

The lack in the awareness about one own process of thoughts and learning is the cause of a often failing in the overestimation of their own degree of comprehension, believing they know more than what they are effectively able to recall under testing [5-8].

Students may vary approach according to their own personal beliefs about science, result- ing even in different, correlated, scholastic performance[9-12].

IT IS ESSENTIAL TO UPDATE PHYSICS COURSES AND TEACHING METHODS TO MEET THE NEEDS OF THE SCIENTIFIC REALITY, GUIDING STUDENTS TOWARDS THE CORRECT COMPREHENSION AND APPLICATION OF THE HYPOTHETICO-DEDUCTIVE PROCESS IN PROBLEM SOLVING AND IN THE DEVELOPMENT AND UNDERSTANDING OF LAB ACTIVITIES.

Exploringing the possibility of introducing activities denominated **"Bayesian updating"** in Italian High school for scientific studies, we tried to elaborate and implement an **on line educational tool** regarding the theory of probability and wave phenomena using the "DESMOS" platform [QR code] to achieve these important skills in students.

IS IT POSSIBLE TO PROMOTE THE DEVELOPMENT OF METACOGNITIVE SKILLS IN PHYSICS' HIGH SCHOOL STUDENTS?

BAYES' THEOREM AND FALSE NEGATIVES

Bayes' theorem is often presented to high-school students as an abstract mathematical tool without a well-defined origin, useful only in ideal situations.

With the purpose of opposing this practice we spent some time discussing and obtaining through calculus Bayes' theorem's general expression. For a deep insight in the theorem's meaning We specifically designed an exercise regarding current actual events. In this way we also showed the theorem's inferential power in a realistic context, that is what we would then do in Physics.

So, we decided to talk about Covid-19 and the related diagnostic tools: we asked students what might be the probability of being infected even though having received a negative result with the swab test (false negative), that was a really problem during the pandemic spread-out.

PROBLEM SOLVING THROUGH UPDATING ACTIVITIES

With the intent of developing problem solving skills we took exercises from a book and re-elaborated them to include Bayesian updating and thought experiment, showing the participants how they can approach future problems being able to self-evaluate their own work and without having to rely on the books' solutions or the teacher's authority. From now on we will analyze a very common exercise about sound waves and the condition of destructive interference. The first step is to ask the students what is their initial level of confidence about being able to solve the suggested exercise. Then the participants are required to actually solve the problem and elaborate a thought experiment to test their so- lution method. The evaluation may consist in a change of parameters or context, with the intent of tracing themselves back to a known situation in which they are confident of what to expect.

TO EFFECTIVELY IMPLEMENT BAYESIAN UPDATING ACTIVITIES TO PHYSICS CURRICULUM IS NECESSARY TO DESIGN SPECIFIC ACTIVITIES AND REELABORATE PROBLEMS AND EXERCISES AS TO INCLUDE THE BASICS STEPS OF THE PROCESS. HERE WE PRESENT THE MAIN CONTENT ASPECTS FROM OUR PROJECT SO THEY MAY SERVE AS EXAMPLES AND THEY SHOW A WAY FOR DEVELOPING A BAYESIAN UPDATING ACTIVITY IN EVERY PHYSICS CLASS AND FOR ANY CURRICULUM STUDY.

LAB ACTIVITIES AND EVOLUTION OF CONFIDENCE

With the same approach we also implemented Bayesian updating to Lab activities to develop basic applied physics' skills. Due to epidemic-related restrictions it was not possible to actually set up a real laboratory, nonetheless the website "The Physics Classroom" [QR code] offers a realistic simulation of Thomas Young's two slit interference experiment with changeable parameters that also requires actual measuring skills. We hypothesized each student bought a red laser from a seller who claims its wavelength is λ = 700nm and asked the students to test this hypothesis through Young's experiment. The simulation changes its unknown parameters at each restart so every participant has a laser of different wavelength causing some to receive a confirmation and others a confutation. The assignment was to complete some given tables that guided them to execute the experience multiple times changing parameters and conditions, updating their confidence after each time. Since the simulation lets them also change colors of the laser, we then asked the students to put to the test not the hypothesis itself, but the evaluation method. We discussed what they expect it would happen with a change of color if the method was correct and then, actually made them try to manipulate the simulation to receive a confirmation or confutation.

ESSENTIAL BIBILOGRAPHY:

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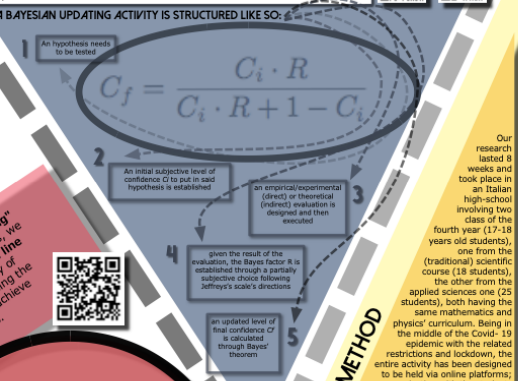
[14] A.R. Warren, Phys. Rev. Phys. Ed. Res. Phys. 16(1), 010101 (2020).

OUR WORK IS GREATLY INSPIRED BY WARREN'S RESEARCH [13, 14 - QR CODES] IN WHICH HE TESTED THE IMPLEMENTATION OF BAYESIAN UPDATING ACTIVITIES TO ALGEBRA-BASED AND CALCULUS-BASED INTRODUCTORY PHYSICS COURSES.

In his papers he designed curricular material to introduce students to the hypothetic-deductive process using Bayes' theorem (**the equation in the circle**) to numerically express and update through a mathematical instrument the level of confidence obtained in a certain hypothesis.

A BAYESIAN UPDATING ACTIVITY IS STRUCTURED LIKE SO:



RESEARCH METHOD

Our research lasted 8 weeks and took place in an Italian high-school involving two class of the fourth year (17-18 years old students), one from the (traditional) scientific course (18 students), the other from the applied sciences one (25 students), both having the same mathematics and physics' curriculum. Being in the middle of the Covid- 19 epidemic with the related restrictions and lockdown, the entire activity has been designed to be held via online platforms; communicating with the students through virtual meeting while discussing an interactive slideshow devel- oped through the "DESMOS" website. The Bayesian updating is an extremely versatile tool that can be adapted to any physics-related subject and in the course of this research we opted for wave phenomena as it was the subject planned by the teachers to occur in that period.

THE ON LINE INTERACTIVE ACTIVITY HAS BEEN SPLIT INTO 3 DIFFERENT SECTIONS:

1. First an introduction to the theory of probability to address all the mathematical tools necessary to proceed in the activity. The main focus of this section is the Bayes' theorem and its possible applications.
2. Second an in-depth analysis of the concept of thought experiment and indirect evaluation applied to wave- related exercises utilizing the Bayesian
3. Third an exploration of the idea of direct evaluation, with the use of Bayesian updating , discussing the structure of experimental data and the concept of statistic and systematic errors and how they can affect the level of confirmation/ confutation

ASSESSMENT

At the end of the activity we made the students submit a survey we purposefully made to evaluate the whole project itself and, moreover, the meta-cognitive impact obtained. The most significant result is that a great number of participants recognize the importance of self-reliability and consider Bayesian updating activities to be effective as a self-evaluation tool.

DISCUSSION AND CONCLUSIONS

There is an incredible adaptability of this kind of activities, applicable to every topic of the physics' curriculum. The nested interplay with the use of the Bayes' theorem is an inter-disciplinary key that confirms the nature of this kind of approach. Bayesian updating activity helps develop basic concept fundamental for the comprehension of every scien- tific topic, not just in physics, suggesting the possibility of implementing this tool to every subject, creating interrela- tions and promoting students' epistemological development in the course of the whole academic year. All said above suggests the need for further explorations and future works about this new approach we adopted, both in high school and university.

UNIVERSITY OF TRIESTE

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POSTER COMMUNICATION AND MESSAGE PROGRESSION

A. **Design the poster like a newspaper article:** from most important to least important information.

B. **Title clarity:**
   - Use the exact research title?
   - Use a more general, attention-grabbing title to attract more participants?

C. **Identify the main message:** what should attendees remember?

POSTER COMMUNICATION AND MESSAGE PROGRESSION

QR code integration for extended content:

A. Contact details of the research author.

B. Research summary (download PDF).

C. Link to full research publication on a website*.

D. Link to a publicly available journal article.

E. Use of interactive charts.

F. Viewing videos (Youtube).

* If you do not have your own website, you can quickly create one using platforms such as **WordPress.com** or **Wix.com**, where you can publish research content and contact details.

POSTER CONTENT

A. **Main elements:**
   - Title
   - Research Summary / Abstract
   - Main Content:
     - » Introduction,
     - » Methodology,
     - » Measurements,
     - » Results,
     - » References,
     - » etc.

B. **Grouping information** - organize content into sections where similar types of information are presented together.

EXERCISE 4

Select one poster and identify the key elements for the content.