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R&I Loop:

Shaping the way Higher Education Institutions do Research and Innovation with and for Society

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1. What is science communication and why is it important for civic universities?

a. Why should we communicate science?

In addition to gaining knowledge and providing evidence, research aims to provide answers to societal questions. To achieve the desired societal impact, scientific knowledge and results must be communicated to and made accessible, understandable, and usable for the public (Molek-Kozakowksa et al. 2022: 59)[1].

Since the beginning of the 21st century, scientific institutions have expanded their science communication. Scientific knowledge is not only simply communicated to society, but academic practices and the know-how are transferred through various participatory formats, where citizens take part in the research work at scientific institutions and researchers and/ or students participate in different societal fields and institutions, for example in civic organizations or policy processes (Molek-Kozakowksa et al. 2022: 59).

In the present era, where an abundance of information is available through various media channels and even mainstream media formats are not fully trustworthy, Higher Education Institutions play an important role in producing high-quality and reliable knowledge.[2]

Science and scientists can provide facts and evidence to help solve discussions that are – more often than not – emotionally charged and divisive, and more focused on the conflict itself, rather than finding a solution through logic and reasoning. So far, scientists are often still rarely visible in public debates. Visibility depends on their field (e.g., social sciences, economy, and medicine are often more visible than other fields) and on the way research fits the current course of events, as e.g., media coverage is event-centred (Covid-19; Ukraine; Climate Change, etc.). Thus, there is wide consensus in academia and society that scientists should become more visible to the public.

[1] Molek-Kozakowksa, Katarzyna/ Mendoza-Poudereux, Isabel/ Moreno-Castro, Carolina (2022): Good Practices in Communication of Science. In: María D. Pitarch-Garrido, María Dolores/ Mendoza-Poudereux, Isabel (coord.): FORTHEM Alliance Universities' Selected Good Practices in R&I. Towards a European University, pp.59-64. Publicacions de la Universitat de Valencia

[2] This pursuit of high-quality knowledge and the aspiration for transparency and transferability not only serves the public, but also offers benefits to the institution itself: These efforts "help build an institution's reputation and, with it, their wider impact by attracting the attention of other researchers, the media, as well as industry and policymakers. This is especially important in the case of universities, as visibility and reputation translate into a higher quality ranking and the extensive enrolment of new students at all levels thereafter" (Molek-Kozakowksa et al. 2022: 60).

b. Types of public visibility

There are two types of public visibility for a scientist: Being a public expert in your field and/or communicating your own entered research (Maurer 2022)[3]

1. *Being a public expert in your field – How the news media choose (scientific) experts*
    - Former media presence (regarding a similar issue)
    - Ability to communicate things in simple language and also with the courage to simplify things in terms of content (e.g., taking a clear position)
    - Taking a position that is similar to the position of the journalist (scientists as credible "opportune witnesses ")
    - Scientists' influence on becoming a public expert is limited, as it is not necessarily related to actual scientific expertise (most journalists are no science experts)
2. *Communicating your research*
    - Scientists can communicate their research directly or via news media.
    - Direct science communication is (almost) mandatory when funding is requested. With this kind of communication, one reaches a small number of specially interested people. Possible channels are a project website, public events, workshops, and social media, mainly YouTube.
    - Science communication via news media (potentially) reaches much larger audiences. However, there is a lack of control and coverage is not guaranteed. Eligible channels are press releases and press conferences, aggregators and social media, primarily Twitter.

c. Factors influencing your media success – some practical advice

- The topic of your research: there is no magic formula that leads to news coverage about the specific research topic you focus on.
- Your engagement: Do the first step. Do not wait until news media contact you (most likely they will not).

[3] Maurer, Marcus (2022, June 21). *A case of great research communications. Keys and Tips* [Presentation]. R&I Loop, C2. Training Workshop, Madrid, Spain.

- Balance is key: On the one hand, it is important to stick to scientific standards and representations. On the other hand, it can be useful to make use of journalistic tools: Use easy language, keep it short and focus on things that are relevant to the public. In press releases add some judgmental quotes ("This finding is a big problem for society because…") and use a text format that can directly be converted to news articles.
- If you are in doubt, use the expertise of your University Press Office.

d. Risks of going public

There is the risk of being attacked as well as the risk of being instrumentalized. Scientists are subject to attacks by people with different worldviews in social media and user comments, which range from simple incivility to death threats in extreme cases. Furthermore, they might be hijacked by interest groups (media, activists) for their purposes.

What to do as the affected researcher: Attacks should be taken seriously. In such cases, advice and help should be sought from experts in communication and law. Furthermore, it should be checked whether formal or even legal steps are necessary. It can be useful to limit communication for a while, but it should not stop a researcher from communicating valid research results.

e. A brief conclusion

- Public visibility is becoming more important for scientists but is not easily achieved
- Various channels for effective science communication reach different audiences
- Larger audiences can only be reached via news media
- There is no magic formula, but there are some tips to increase public visibility
- There are risks to public visibility
- These risks should not prevent you from going public.

2. Self-assessment questionnaire as a tool (and first results): What is being done in your organization to foster science communication or what needs to be further improved?

This section presents the results of the self-assessment questionnaire - focusing on science communication and the transfer of research into policy and practice – are

presented. The questionnaire serves as an internal tool, to analyse the current status and needs of the partners. Participation was anonymous, referring to all individuals of the partner organizations involved in the consortium. The results will be presented in a summarized and aggregated form.

The partner organizations understand science communication as the transfer of, and education about scientific discoveries and information to the target audience. In addition, for some participants, science communication has the ambition to raise awareness and interest in the research itself and certain topics.

The participants state that the communication of science is important to create a bridge between science and the public members. The inclusion of citizens and the co-creation of science might not only be fruitful but is also essential for the legitimacy and the acceptance of science being a part of society. Furthermore, science communication is important for the dissemination of knowledge and the support for sound and effective decision-making.

When partners are asked about theories, concepts, or models that they associate with science communication or that are prominent in their organization, the participants mention different forms of science communication. Beyond formal communication, they name participatory science communication, research contests among PhD students, as well as creative and narrative forms like gamification and storytelling. This plurality of possible communication forms as well as the importance of digitalization is highlighted.

Looking concretely at what is already being done in their organization to foster science communication or what needs to be further improved, the participants refer to freely accessible databases for university members, as well as public events or project classes for citizens who are personally interested in scientific research. These events foster the connection between society and science. Furthermore, institutional services like scientific websites and blogs, which provide scientific information for interested parties, are listed. Regarding the reinforcement of science communication and its relevance within the institution, training activities, where members of the Higher Education Institution can learn about the practical and creative implementation of science communication, and university intern promotion events on the relevance of science communication are mentioned.

Thinking about the involvement of stakeholders like policymakers, businesses or public authorities, and the public in the work of their Higher Education Institutions,

social media as well as hosting events play an important role in involving the public. Other relevant stakeholders get involved through (funded) national and European projects. The strategy of involving the stakeholders to the research program is expected to lead to shared commitment and inclusion.

The main channels of communication with the stakeholders are the Internet (e-mails, social media, research channels), short newspapers/reports, and meetings. Further communication activities are offline events, press releases, posters, patents, and networking with other projects.

The accessibility of activities and results is once again mainly provided through online research channels such as social media, emailing or papers. Results are primarily shared with involved stakeholders, researchers, supervisors and – when needed – with other colleagues. When the provision of tailored information and education resources to specific stakeholder groups is necessary and/ or beneficial, the universities specifically direct their information and resources to the stakeholder group through emails, newsletters, and reports, giving presentations and via video calls or meetings. Channels like social media or websites are used for this purpose as well.

Further considering public accessibility, the partners were also asked if their organization approaches an open access policy and, if so, how it is integrated. Open Access is an integral part of the concept of Open Science. Open Science – defined by UNESCO – is "an inclusive construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone, to increase scientific collaborations and sharing of information for the benefits of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community" (Barrueco 2022: 44).[4] The component of Open Access refers to the free accessibility and usability of research literature through any interested person. The participants were not able to provide much information about this. This may be due to a lack of information or because no such approach is undertaken. They stated to support the provision of open access by encouraging their researchers to publish their publications in open access journals. Furthermore, the deposit in the university's digital archive is mentioned.

[4] Barrueco, José Manuel (2022). Good Practices in Open Science. In: María D. Pitarch-Garrido, María Dolores/ Mendoza-Poudereux, Isabel (coord.): FORTHEM Alliance Universities' Selected Good Practices in R&I. Towards a European University, pp.43-49. Publicacions de la Universitat de Valencia.

Reflecting on what needs to be further improved in their organization to foster effective science communication, the participants named a variety of features that need to be enhanced. First and foremost, the creation of more learning opportunities for internal staff is mentioned, including individual courses, workshops, and presentations. In addition, the organization of initiatives and public events focusing on open participatory science communication and co-creative citizen science is seen as a good possibility. A need for the standardization of adequate science communication tools and strategies is mentioned as well. Another aspect is to expand and enhance research on public engagement.

One prominent aspect of science communication is the integration of research in teaching and learning. As can be read in Chapter 3, there is a variety of approaches that a university can undertake to offer students the possibility to carry out or participate in research processes. When asked about the integration of research in teaching at their university, the participants do not get specific. They stated that research is partially incorporated where possible. This mostly refers to research results although the participants claim to be familiar with didactic concepts like learning by doing approaches and research-led/tutored/based/oriented methods.

The motivation for the consortium partners behind integrating research in teaching lessons lies in strengthening interactions between research and teaching as well as enhancing student learning and employability by developing skills of critical inquiry. Furthermore, the integration is hoped to attract the students to scientific work and research results.

Companies, policymakers, research centers, agencies and associations are mentioned as stakeholders that take part in the organization's educational activities.

Looking at what is being done to support research-based learning in their organization and what needs to be further improved, learning activities targeted at researchers as well as open labs with the participation of researchers, students and the public are mentioned. One university further refers to the development and establishment of an educational model through the European Engineering Learning Innovation and Science Alliance **(EELISA)** that aims at facilitating the participation of students and external entities in different thematic communities to resolve socioeconomic problems as an ongoing activity.

Looking at the bigger picture, the project partners were asked to assess how science communication and research-based learning contribute to more civic universities.

They stated that it leads to the democratization of science while involving non-researchers in sciences and it facilitates the dissemination of open access events. The society of knowledge requires fluid communication between knowledge-producing institutions and their public. Knowledge of the main development paths of scientific-technical research, and its main risks and benefits is a fundamental element of contemporary culture, and the existence of specialized communicators is essential. Science communication and research-based learning are thought to enable that.

Specifying the activities a civic university should perform in this regard, the participants state that there should be a better institutional framing and a greater variety of the offered activities. The framing refers to better measurement of outcomes, more use of theory and more student involvement in institutional governance. Regarding the offer of activities, universities should be more creative and expand their civic education work beyond curricular engagement experiences. More technical and scientific writing initiatives, that equip students and researchers with the skills to publish in journalistic formats, consult political actors and speak to the public through common media channels are given as examples.

As part of the self-assessment questionnaire presented above, the participants were also asked to indicate activities that are being done or can be done to disseminate vs. communicate science at their organization.

The participants differentiate between dissemination and communication, particularly in terms of the language used and the target group. Dissemination refers to the transmission of research results to relevant stakeholders like the scientific community, policymakers, and industry. Using scientific language in these relations is important to demonstrate accuracy and reliability. Science communication, however, refers to the process of distributing scientific research results and/ or making projects visible to the general public. In this regard, it is important to use accessible language to ensure understanding and correct transmission.

3. Practical implementation and improvement: Toolkit for Improving Science Communication

a. Types of communication (Holmes 2005:85[5], Hollows 2016)[6]

There are various types of science communication. Four essential types are the following:

Writing

Writing is the first type of science communication. It is useful in spreading the research to people interested in the topic. The forms of writing communication are

- Blog, interview, comment (focus on general public)
- Research article, book, educational resource (focus on a specific audience)

Broadcast

Another way to spread knowledge and research to an extended audience is to use audio and broadcast media in various formats

- TV, radio, podcast, YouTube (focus on general or specific public depending on the platform)

Face-to-Face

Face-to-face communication has its pros and cons. It may be the most useful way of communication, but this type of communication is rather limited regarding the size of the audience it will engage with

- Talks, panels, debates, workshops (focus on general or specific public depending on the event)

Social Media

- Twitter, Facebook, Instagram, Snapchat, TikTok

To choose one of the four communication types, three questions should be considered:

1. *Which type of communication is best suited for my purpose?*

Depending on your purpose, different media should be used:

- To reach more people: Broadcast

[5] Holmes, David (2005). *Communication Theory: Media, Technology, and Society*. Sage Publications.
[6] Hollows, Joanne (2016). *Media Studies: A Complete Introduction: Teach Yourself*. Hachette.

- Personal interaction: Face-to-face
- Detail on the content: Writing

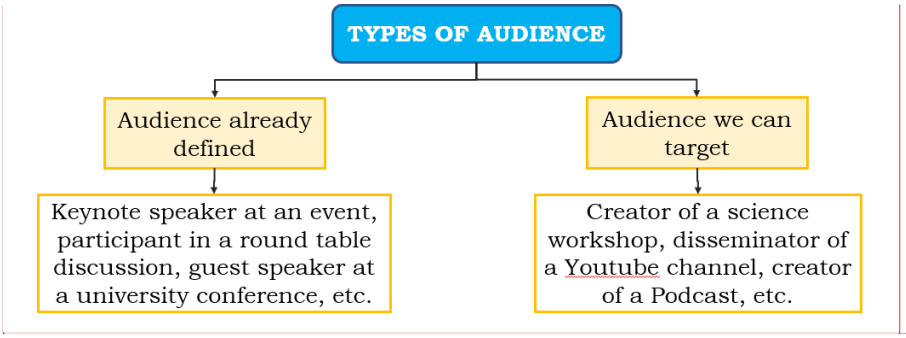
2. *Which type of communication is best suited to reach my target audience?*

   Depending on the audience, different media should be used:

   - Non-experts: Social media
   - Experts: Writing or face-to-face

3. *Which of these media am I comfortable in and have the resources to use?*

b. Types of audience (see Sullivan 2012)[7]



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The "Who" is closely related to the "Why". It may be that depending on the "Why", the audience is decided, or it may work the other way around.

The success of your science communication depends on how well you can tailor it to a particular audience. Each science communication will be different and will have to be adapted to the characteristics of the environment and the event. However, the fundamental objective must be to engage the audience with the presentation and the message you want to communicate.

It is important to have a methodology in place so that audience engagement can be considered from the very beginning of science communication preparation.

There are five aspects to consider when defining whom you are trying to engage with your science.[8]

[7] Sulivan, John (2012). *Media Audiences. Effects, Users, Intuition, and Power*. Sage.
[8] It is important to remember that sometimes we can decide the audience we want to reach with our messages. However, in other situations, the audience will be chosen for us.

Rule #1 to engage your audience: "Aiming to engage everyone will usually reach no-one"

The list of groups to involve in our communication is long. There are even subdivisions into smaller groups. To be successful, it is necessary to change your content, your language, and your style to engage different audiences.

→ From the moment you start preparing a communication, it is essential to decide which groups you want to engage.

Rule #2 to engage your audience: "Know thy audience"

Once the target audience has been identified, it is necessary to find out why they are different from any other audience. Effective communication is about being able to read your audience's mind. To do this, it is necessary to collect and analyse information about the target group. As known, evidence, that is data, is key in science. It is also essential in science communication.

→ Before preparing the presentation we want to create, it is necessary to answer the question: What is particular about this group of people?

Rule #3 to engage your audience: "What do they (your audience) care about?"

We are all different. But when communicating with the public, it is important to find out what the involved people have in common, i.e., what interests, concerns, and goals they share and find the connection to your science/ research. It is important to know what our audience is concerned about. They will need to care about our science/research first, before they invest time in understanding it.

Practical advice:

When defining an audience profile, rather than thinking of a generic audience member profile, it is more useful to think of a range of audience representatives. This approach can be used with members of a known audience or to identify new audiences to target. The following template may be used as a support tool:

Name: _____

Age: _____

Interests: _____

_____

Concerns: _____

_____

Goals: _____

_____

These resources were developed by BBC Science Presenter & YouTuber Greg Foot
as part of the first ever YouTube Course on Science Communication, kindly supported by Google.
The Course is written by Greg, produced by his specialist scicomm consultancy
& digital-first production company sciencemedia.studio, and filmed & edited by Kūmba Creative.

[9]

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→ From this profile, a series of elements can be defined, for example, what is the best channel to contact that person or what challenges may arise in contacting them.

Rule #4 to engage your audience: "What do they (your audience) know already?"

It is important to know to what extent the audience is familiar with the communication issue. To collect this information, it is necessary to do some research: Ask the organizer of the event, use previous data, conduct surveys, etc.

Another important element is: How much does the audience think they know about it? The answer to this question will help to clarify certain misunderstandings from the outset

→ Before preparing the speech, it is necessary to know the audience's prior knowledge of the subject to adapt the content of the communication to the expertise level.

Rule #5 to engage your audience: "Put on someone else's shoes"

We all have different levels of sensitivity to certain issues. It is important to consider the views of others when communicating with them. It is helpful to stop for a moment and consider which points in our speech may be considered controversial or worrying by the audience. These considerations must be considered in international communications and with people from different cultures, but also at a local level.

[9] Foot, Greg (2020, November 5). *An Introduction To Science Communication | YouTube Course [Video].* YouTube. https://www.youtube.com/playlist?list=PLD160RWuGai9oUnAVRq-GD2njEo1XHadF

→ To tackle these more controversial issues, it can be interesting to have a two-way debate or discussion, to consider all points of view.

4. Integrating research in teaching and learning

a. What is research-informed teaching? (RIT)

Research-informed teaching is a term used to describe the different ways in which students are exposed to research content and activity during their time at university.

RIT consists of offering students the possibility to carry out or participate in research processes. In these processes, students apply methodologies to check the veracity, or lack thereof, of hypotheses to provide a response to a problem or question. While doing so, they are accompanied and supervised throughout the process.

This approach can be summarized as 'learning by doing'. That is, learning from the generation of knowledge itself. Thanks to teachers being involved in the constant research processes and being able to accompany, advise, and tutor their students through their research processes and projects (see Flood 2020)[10]

b. Relevance: Why should we integrate research in teaching and learning?

The main goal is to bring research closer to the teaching and learning process so that a better understanding of the role of research in learning and how knowledge is constructed and produced within a discipline is built.

Hence, a strengthened interaction between teaching and research for teacher and student is created.

All students – not just research students – will develop skills of critical inquiry, such as critical appraisal, reflection and analysis, problem-solving, and the ability to apply evidence-based solutions. Thus, it improves performance more than just having average classroom instruction and enhances student learning and employability in ever-changing fields of study (e.g., design). Moreover, it creates fruitful student-teacher relationships beyond the classroom which can lead to future projects and collaborations.

c. Concepts for research-informed teaching (RIT)

There are four ways of doing RIT:

[10] Flood, Jane (2020). *Research -informed Teaching Revolution. A Handbook for the 21st Century Teacher*. John Catt Educational Ltd.

- Research-tutored teaching
- Research-based teaching
- Research-led teaching
- Research-oriented teaching

Research-tutored teaching

Students engage in research discussions, which means they find, examine, and discuss current research from the discipline with peers and teachers. The development of critical thinking and deep approach to learning is the focus.

Hence, students themselves contribute to the learning and teachers will only play a support role in this process.

An example could be: Discussing the main papers indexed concerning Civic Universities.

How to implement it?

Engaging in discussion is a key way to develop understanding. Traditionally in higher education, this takes place through staff-led academic tutorials and seminars.

Other ways can be:

- Allowing students to do primary research from the first year
- Engaging students with an online community
- Designing activities so that students work collaboratively on the analysis of an international journal article
- Asking students to devise a question for the author of a research article and email that question
- Developing an activity that involves students in critical analysis of the research literature on a topic
- Designing learning activities that are inquiry-based, problem-based and that incorporate authentic learning experience
- Setting assignments that require students to engage in research processes like locating, collecting, referencing, critiquing, applying evidence, challenging assumptions, questioning, and interpreting

Research-based teaching

Research-based teaching is about undertaking research and inquiry. The keyword is inquiry, regarding questioning and exploration. Students learn as researchers, and inquiry follows research processes and problems.

This approach is student-based: Students are participants. Hence, division between teacher and student in this inquiry process is minimized and collaborative inquiry with students as partners may occur.

How to implement it?

- Setting assignments that require to engage in research processes, with emphasis on the connection between research and learning
- Co-producing knowledge with students and lecturers
- Work-based learning opportunities and practical activities.
- Digital conferences
- Getting students to work in small groups to conduct research and allow them to publish their findings as a practical activity

Research-led teaching

Research-led teaching aims at learning about current discipline content and research findings. The content is strongly linked to staff research interests.

The learning occurs through reading about research (generally and in the discipline) and reflecting on the results.

Thus, information transmission is the main teaching mode to teach students about discipline content research findings. Students are not direct contributors to the research; they are more of an audience-like figure.

An example could be: A teacher bringing in their research for students to reflect on the findings.

How to implement it?

Students can be engaged with current research in a discipline in a variety of ways, including through lectures, laboratories, course work and seminars led by academic staff.

Other ways include:

- Explicitly introducing students to reading and to writing as researchers

- Developing a set of exercises that assist students to consider the structure of a scientific report and read and evaluate a research paper
- Asking students to interview a member of academic staff about their research and write a report
- Allowing researchers to present current work to students of all years in a conference-style format
- Inviting speakers from a variety of potential research employers and asking them to present

Research-oriented teaching

Research-oriented teaching emphasizes the development of research and inquiry skills and techniques. The curriculum emphasizes the processes by which knowledge is produced. Students learn about research processes in the discipline and the teacher builds a research ethos.

Learning can focus on improving teaching practice through research processes and reflection, but students are the subject of the inquiry.

How to implement it?

"Assisting undergraduates to develop research skills and techniques is a key aspect of the intellectual journey of students as they develop as researchers." (Healey & Jenkins, 2010). Course lectures, practical and laboratory classes and course work are common modes of teaching in which research skills and techniques are particularly emphasized.

Other ways include:

- Developing a practical exercise that engages students in making observations; coming up with questions; sharing questions with another group of students; coming up with hypotheses based on the question as a group; thinking of ways of testing the hypothesis; and writing up their questions and a hypothesis as a mini proposal for a research project individually
- Dealing explicitly with some of the common questions, concerns, and practical issues that undergraduate students
- Developing students' skills for inquiry-based learning and embedding them in a module
- Getting students to inquire into and develop a proposal

- Auditing and developing student research skills
- Adapting assessment tasks explicitly and systematically to develop student research skills

5. Annex

Annex I. Toolkit for improving science communication

a) Templates, tools, and resources

QUESTIONNAIRE ON RESEARCH AND SCIENCE COMMUNICATION

"What is being done and can be done to communicate science in an effective way?"

Dear R&I LOOP Partners,

The following questionnaire - focusing on science communication and transfer of research into policy and practice - serves as an internal tool, to analyze the current status and needs of the partners.

The questionnaire is anonymous, referring to all individuals of the partner organizations involved in the consortium and the analysis of the responses will be done by JGU.

Thank you for your time and support!

i) At which institution are you employed?

Click or type here to enter text.

ii) What is your role there?

Click or type here to enter text.

1. What is science communication and why is it important?

iii) What do you consider to be science communication?

Click or type here to enter text.

iv) What theories, concepts, or models come to mind or are prominent in your organization regarding science communication?

Click or type here to enter text.

v) Why should we communicate science? Why is it important?

Click or type here to enter text.

vi) What is being done in your organization to foster science communication or what needs to be further improved?

Click or type here to enter text.

2. Dissemination vs. Communication: activities and strategies

i) What activities are being done or can be done to disseminate vs. communicate science at your organization?

Click or type here to enter text.

ii) How do you involve stakeholders and the public in your work?

Click or type here to enter text.

iii) What are your main activities to communicate with diverse stakeholders?

Click or type here to enter text.

iv) How are your communication activities made accessible to diverse stakeholders?

Click or type here to enter text.

v) Does your organization approach an open access policy? How is it integrated?

Click or type here to enter text.

vi) With whom do you share the results of your work?

Click or type here to enter text.

vii) How do you provide tailored information and education resources to specific stakeholder groups?

Click or type here to enter text.

viii) What needs to be further improved in your organization to foster effective science communication?

Click or type here to enter text.

3. Integrating research in teaching and learning

i) Do you integrate research in your lessons/classes/teaching?

Click or type here to enter text.

ii) Which stakeholders are taking part in your education activities?

Click or type here to enter text.

iii) What motivates you to involve research in your teaching/lessons?

Click or type here to enter text.

iv) How do you engage your students to participate in research or science?

Click or type here to enter text.

v) Are you familiar with specific didactic concepts to promote research-based learning?

Click or type here to enter text.

vi) What is being done to support research-based learning in your organization and what needs to be further improved?

Click or type here to enter text.

4. Science communication and civic universities

i) How do both, science communication and research-based learning, contribute to more civic universities?

Click or type here to enter text.

ii) What type of science communication and research-based learning activities do/or should civic universities perform?

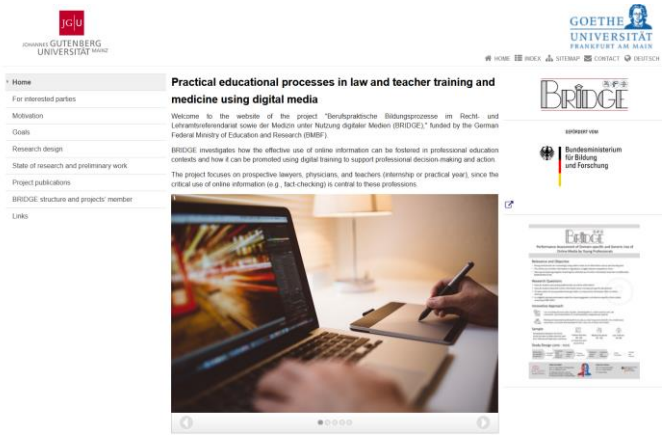
Click or type here to enter text.

b) Practical examples of science communication (at JGU Mainz and other institutions)

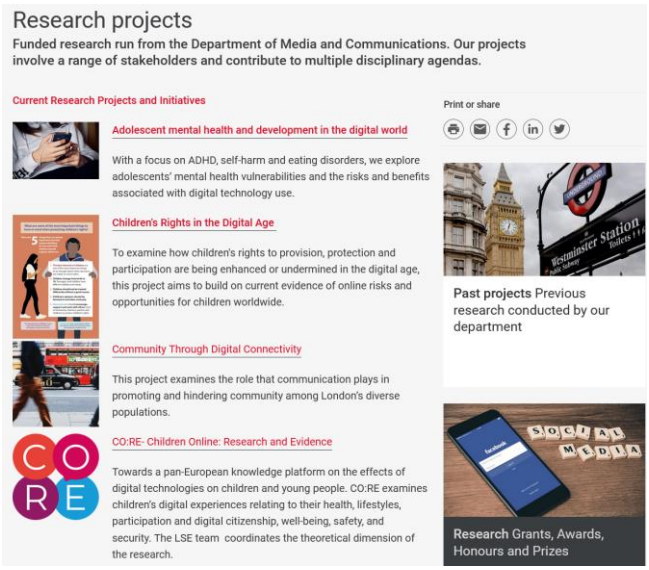
a) Websites of research projects

Generally, most funded projects by the EU and other institutions are required to have a web presence (either a dedicated website or to be part of an existing website). It should provide details about the project objectives, actions, progress and results. Therefore, it is common for higher education institutions to communicate their state of research via specific websites on which current project developments are presented. The websites usually provide information on the project's structure and members, funding, motivation, goals, research design, state of research and preliminary work, as well as journal publications and further related links.

One example is the research project BRIDGE at JGU Mainz, which investigates how the effective use of online information can be fostered in professional education contexts and how it can be promoted using digital training to support professional decision-making and action. The website (https://eng.bridge.uni-mainz.de/) lists all project related information and allows interested parties as well as stakeholders to gain insight into the current course of the research project.



Apart from JGU Mainz and the BRIDGE project, higher education institutions of all faculties and subject areas around the world run comparable websites. Further examples are The London School of Economics and Political Science in the UK, presenting their funded research projects at the Department of Media and Communications, in which a variety of stakeholders of interdisciplinary areas is involved (https://www.lse.ac.uk/media-and-communications/research/research-projects).



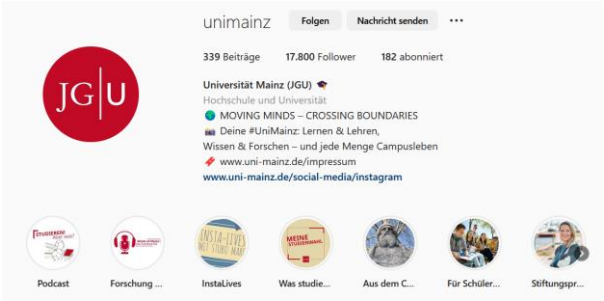
Similarly, Leiden University in the Netherlands lists individual websites of their research projects ranging from microbial sciences to cultural anthropology and development sociology (https://www.universiteitleiden.nl/en/research/research-projects). In all examples, the duration, involved parties, and the research foci are transparently and comprehensibly described. By this means, audiences which are not directly involved in the listed projects or which are working in other fields have a possibility of obtaining an overview of current studies, which is extremely important for the purpose of civic universities.

b) Instagram accounts

Further, research institutions are encouraged to share their project's news and stories via social media, among which Instagram is a commonly used platform. As Instagram can be downloaded onto various digital devices, such as mobile phones and tablets, Instagram has a predominantly young adult audience. Increasingly, non-profit organisations and political parties use it more often as a tool to generate an interested and engaged following for their campaigns.

As an example of a higher education institution, JGU Mainz hosts several Instagram accounts of the university on its own and related affiliations (see https://www.instagram.com/unimainz/?hl=de). Apart from current news on upcoming events and

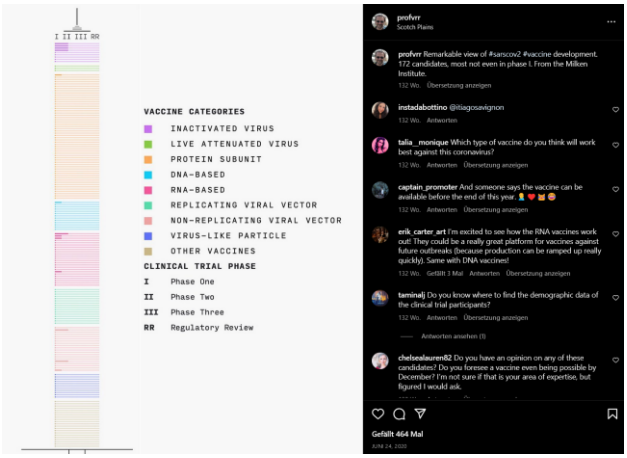
speeches, live broadcasting sessions are held, which allow the audience (mainly students) to ask direct questions to the speakers. The speakers are mainly faculty members of university affiliations as well as stakeholders of external cooperation partners.



Further examples of university Instagram pages with a large number of followers are Harvard University in the USA (https://www.instagram.com/harvard/), Cambridge University in the UK (https://www.instagram.com/cambridgeuniversity/), and Bogaziçi Üniversitesi in Turkey (https://www.instagram.com/UniBogazici/). Apart from entire higher education institutions, there are also individual faculties, professors, and even PhD students that are running Instagram pages in order to promote and communicate their research findings. One example is the PhD student Daisy Shearer at Surrey University (UK), who is performing research on neurodiversity and who is regularly updating her audience on research findings and journal papers she is focusing on (https://www.instagram.com/notesfromthephysicslab/).

Another great example is Professor Vincent Racaniello, who is a internationally renowned virologist at Columbia University (USA) informing his Instagram audience about current

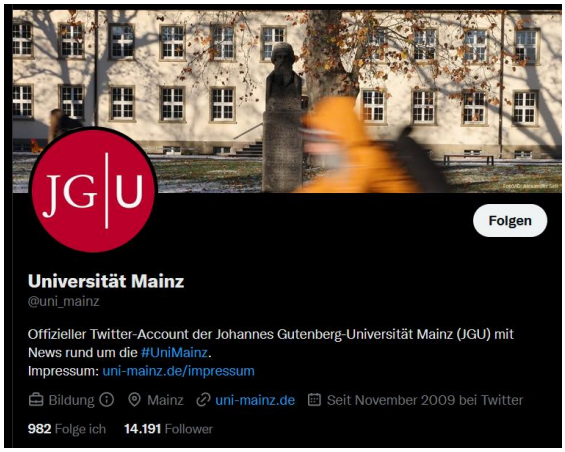
research updates in virology and microbiology (https://www.instagram.com/profvrr/). Especially during the Covid 19-pandemic, he used social media to educate his audience on the structure and functioning of viruses, disease transmission, and vaccination, regularly exchanging and updating information with other professors in this field.

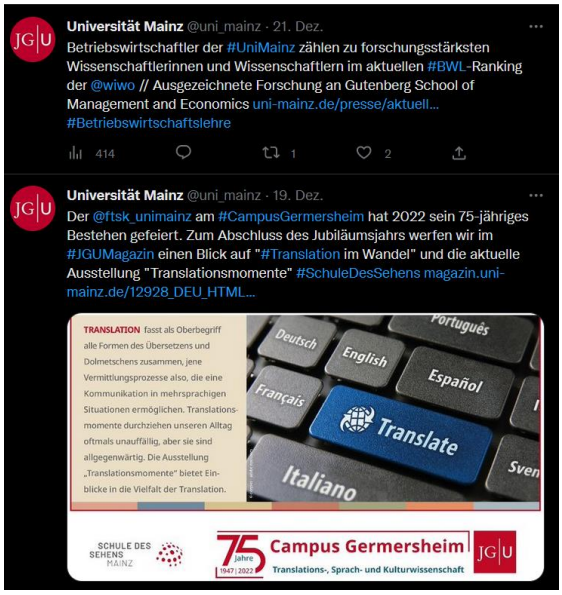


c) Twitter accounts

It has been explained in detail that the scientific process depends on social interactions, involving the communication and dissemination of research findings, evaluation and the discussion of scientific work, and collaboration with other scientists. Social media, including Instagram and specifically Twitter, has accelerated the ability to accomplish these goals. As a result, also Twitter is used by scientists among the world to communicate research in the academic but also public community. The published Tweets are amplified through likes and retweets, which allows a user to share another's message with their own audience, who can further amplify the message by sharing it with their followers. Besides, related useraccounts can be tagged and searchable hashtags included in the Tweets in order to reach a larger audience.

In addition to its Instagram page, JGU Mainz and related affiliations run Twitter accounts on which, similar to the Instagram pages, current news on upcoming events are published. The Twitter pages are also used to communicate press releases and trends in higher education (https://twitter.com/uni_mainz).





Further examples are Twitter accounts of publishers of scholarly books or academic journals, such as the Journal of Investigative Dermatology and JID Innovations (https://twitter.com/JIDJournals), faculties of higher education institutions, including the Faculty of Medicine at Imperial College London (UK) (https://twitter.com/ImperialMed), and, equally to Instagram, university professors and faculty members, such as social psychologist Jennifer Aaker, who is Professor of Marketing at Stanford University (https://twitter.com/aaker).

Annex II. Toolkit for implementing research-informed teaching (RIT)

As introduced in section 4, RIT encompasses different ways in which students are exposed to research content and activity during their time at university. The following section serves to provide templates, tools, and resources as well as practical examples which are currently being implemented and incorporated in the study curricula of Business and Economics Education at Mainz University. All of the presented RIT approaches are based on the international research program "Positive Learning at Risk" (PLATO) which involves worldwide cooperation partners (https://www.plato.uni-mainz.de/). Established in 2016, the project aims at understanding how learning in contemporary, multimedia learning environments takes place, and forecasting and positively influence how learning on the Internet may develop in the future. Specifically, at the Chair of Business and Economics Education of Mainz University, several subprojects focus on the critical handling of online media while solving information problems on the Internet (for details, see Zlatkin-Troitschanskaia 2021, Molerov et al. 2020, Nagel et al., 2020, Schmidt et al., 2020). During their studies, students are involved in different stages of the overall research cycle of the respective subprojects, as presented below:

- *Incorporating Research into Term Papers, Bachelor's and Master's Thesis*

The first approach to practically implement RIT is the development of term paper topics as well as Bachelor's and Master's thesis topics in alignment with a research project's goals and student interest. Depending on the focus of an actual research project and the expected scope of a term paper or final thesis, students are asked to collect, analyse, or evaluate required and/or existing data. They are thus directly confronted with an authentic research problem and its material, such as questionnaires, interview records, or multimodal data sets. Depending on their requirements for research, the respective project team members provide superordinate themes of thesis topics (see below) and supervise the students during their writing process. The advantage of this methodology is that, on the one hand, students gain insights and experiences in the actual research project, and in this way, develop their research habitus. On the other hand, students perceive their work to be of actual relevance and connectivity to the most current research as well as practice. Practice at Mainz University has shown that this bilateral approach has a positive effect on students' motivation in writing their thesis and, additionally, contributes to the respective research. The thesis results can be used to revise or pursue the project development and/or follow-up research projects. However, the utility of the outcomes highly depends on the student's abilities and the resulting quality of the thesis. Therefore, it is recommended to discuss the distribution of especially complex thesis topics beforehand

and consider specific individual strengths and deficits among students already during the specification of the themes of thesis topics.

Template for Thesis Topic Proposals (to be presented to students)

Topic	***General Topic of Underlying Thesis***
Supervisor	*Professor / Lecturer*
Number of Theses Provided within this Topic	XX
Research Relevance and Background	*Short description of the research topic's relevance, problem, and background; the purpose of the research project*
Scientific Methodology/ Underlying Data / Theoretical Basis	*Qualitative/ Quantitative Research; Literature-Review; Specific concepts or data which is necessary to solve the research problem of the thesis*
Concrete Proposals	*Concrete proposals of theses foci / suggestions for preliminary thesis titles* *hint to students: foci / titles should be specified and adapted in accordance with the supervisor*
Prequisites	*Specific interest, previous knowledge, abilities (i.e., skills in data analysis, statistics, foreign languages, programs) required*
Peculiarities	*Into which research project is the thesis embedded; is it interdisciplinary; does it include cooperation with companies, etc.*
Websites and Literature	*Website of the research project; related literature to provide a first insight into the topic*

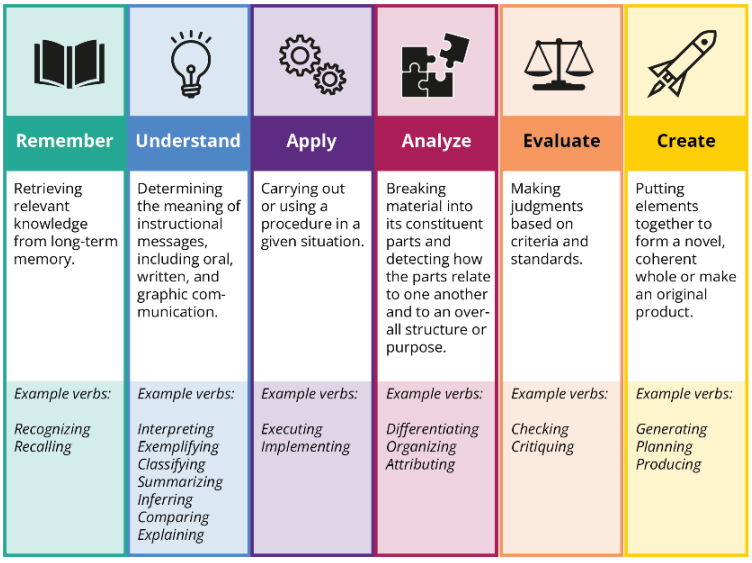
- *Incorporating Research into Seminars – Example: "Advanced Diagnostics, Evaluation and Assessment in Business and Economics Education"*

A second approach is the integration of research into seminars, in which students are engaged to carry out research activities, depending on the selected concept of RIT (see 4.c). To assure that all students are actively engaged in research during their studies regularly, it is recommended that seminars and their respective learning objectives and requirements are formally embedded in the study curricula and guidelines of the respective study track.

A practical example is the seminar "*Advanced Diagnostics, Evaluation and Assessment in Business and Economics Education"* at Mainz University, which is an obligatory seminar for all Master's students of this degree program. The seminar contains the realization, evaluation, and critical reflection of real empirical research projects at the Chair of Business and Economics education in autonomous responsible groups. At the beginning of the seminar, students are confronted with the relevance, focus, and problem of an ongoing research project. Supervised by their lecturers, they are then asked to develop a specific solution to a research problem, such as an interview guideline, a questionnaire, a task for an assessment, or a rating scheme. In the example of PLATO's research subprojects, which focus on the critical handling of online media on the Internet, students were asked to develop assessments asking test persons to perform research on the Internet. Their task was to design an assessment about a controversial topic, i.e., in politics or health, which requires a test person to retrieve trustworthy online-information consulting search engines, databases, and websites. Throughout the semester, several autonomous groups developed assessments which, in turn, were included in actual assessments of the research project at the chair. Again, the awareness that their working results would be used in actual research positively affects the students' working attitude and commitment. Further, working in groups allows the students to divide work according to their skills and interest as well as assist and cross-check interim results.

- *Conceptualization and Implementation of (E-Learning) Training Methods*

A further approach to practically implement RIT is the realization of training methods incorporating an underlying research project, either in person or via e-learning platforms. This approach is best demonstrated through the example of a web-based training (WBT) which has been conceptualized and implemented in one of PLATO's subprojects at Mainz University. More specifically, the project team developed a theory- and evidence-based learning- and assessment environment which intends to foster the domain-specific and generic use of online media among students and young professionals. The result is a WBT which users can easily access online, and which navigates them through different modules teaching them effective strategies to search, evaluate, select, and use online media. With this approach, students (as users of the training) are interactively confronted with the research project and simultaneously acquire skills contributing to lifelong learning in alignment with the project goals. Further, this approach allows them to practice their skills independently of time and location. However, especially e-learning methodologies of RIT are complex to design. To establish and achieve meaningful learning objectives, they require experts in both fields, didactics as well as IT. As a result, it is necessary to determine clear learning objectives and their operationalization before the actual technical implementation of a training method. A useful tool for the development of such learning objectives is Bloom's taxonomy, as presented below. An effective training method intends to progressively incorporate all of the cognitive development levels as shown in the taxonomy (from left to right):



Remember	Understand	Apply	Analyze	Evaluate	Create
Retrieving relevant knowledge from long-term memory.	Determining the meaning of instructional messages, including oral, written, and graphic communication.	Carrying out or using a procedure in a given situation.	Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.	Making judgments based on criteria and standards.	Putting elements together to form a novel, coherent whole or make an original product.
Example verbs: *Recognizing* *Recalling*	*Example verbs:* *Interpreting* *Exemplifying* *Classifying* *Summarizing* *Inferring* *Comparing* *Explaining*	*Example verbs:* *Executing* *Implementing*	*Example verbs:* *Differentiating* *Organizing* *Attributing*	*Example verbs:* *Checking* *Critiquing*	*Example verbs:* *Generating* *Planning* *Producing*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