EMPHATIC QUESTIONNAIRE

WP2

RESPONSIBLE PARTNER: MPŠ

Authors: Andreja Abina (MPŠ), Aleksander Zidanšek (MPŠ)
Contributors: Alenka Temeljotov Salaj (NTNU), Mara Diaconu (NTNU), Cristina Canal (UPC), Francesco Tampieri (UPC), Anton Nikiforov (UGent), Karen Leus (UGent), Tatiana Banderova (UL), Alexandre Nomine (UL)

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1. Introduction

1.1 What is an emphatic questionnaire?

- a survey designed to understand and assess the emotional states, needs, and preferences of individuals;
- focus on how participants feel in different situations, how they perceive others' experiences, and how these experiences impact their learning or interactions;
- gather information about participants' needs and preferences to tailor educational content, methods, or environments that better suit their learning styles;
- encourage participants to reflect on their personal experiences and emotions, and how these influence their learning, fostering a more personalized and adaptive learning experience;
- possible to assess how well students connect with the material and how their emotional states influence their learning competencies, helping to shape more effective teaching approaches;
- a key role in designing educational content that adapts to the individual needs and emotional states of students, leading to improved learning outcomes.

1.2 Why is it important for the IGNITE project?

An emphatic questionnaire is a tool designed to gather information about students' emotional and cognitive preferences. The goal is to create learning video content that resonates with students' learning styles, motivations, and emotional needs, ensuring a more personalized and effective learning experience. The questionnaire will identify preferences for the pace, interactivity, and structure of videos, ensuring that the digital nanomodules are emotionally engaging and cognitively stimulating for diverse learners from various cultural and educational context. The questionnaire will support to create video-based nanomodules that are not only educational but also empathetically aligned with students' needs, improving their engagement with the material on digital and social media platforms. The emphatic questionnaire will be integrated as a tool in the IGNITE application for tracking competence development. The questionnaire will determine the student's learning style, which will be utilized by the e-assistant to recommend suitable additional training sessions, workshops, lectures, and webinars for the student to attend. The learning approach will be tailored to the individual's specific learning style.

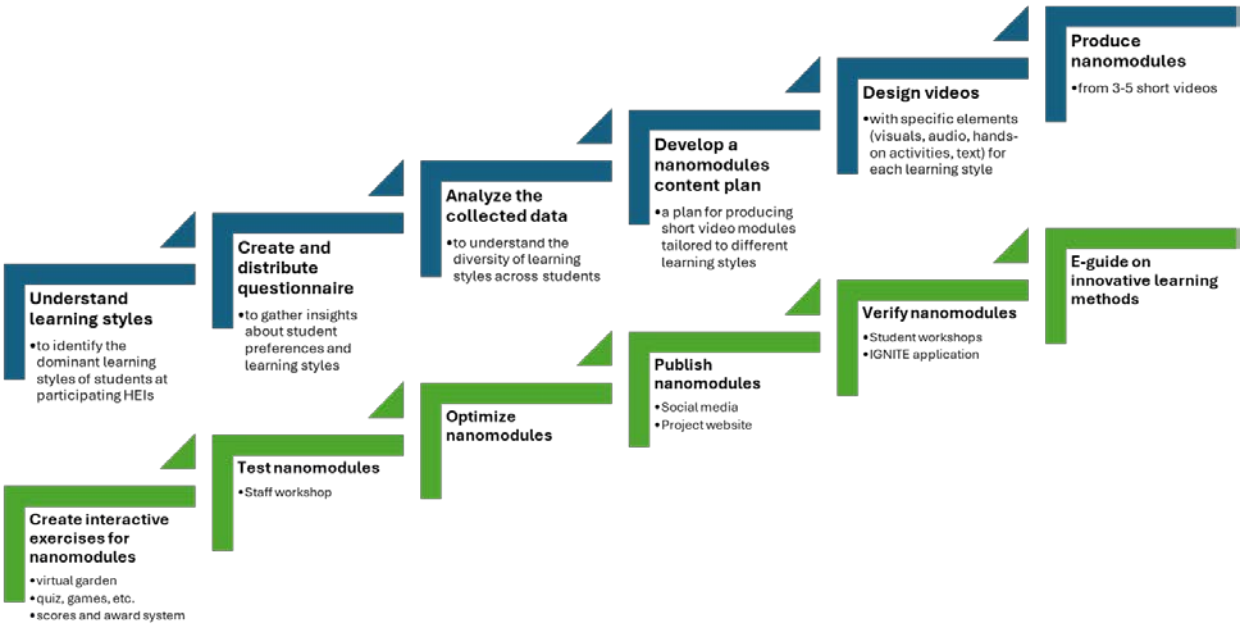

Figure 1. Step-by-step development and testing of nanomodules

2. Learning styles

2.1 Cognitive learning styles

Description: This category focuses on the different ways in which learners process information and how they prefer to receive and process new knowledge. Learners in this group differ in whether they prefer to rely on visual, audio-visual or hands-on experiences. These styles include strategies for acquiring knowledge and understanding content.

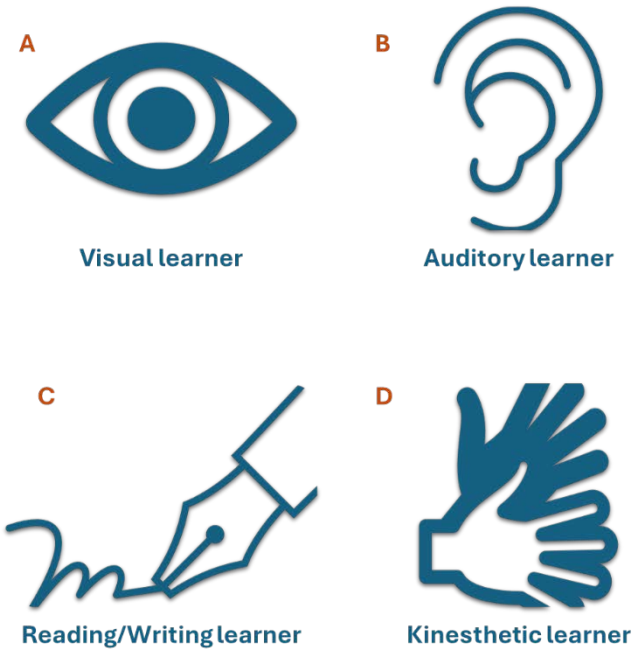

Figure 2. Cognitive learning styles

Visual learners prefer to absorb information through images, diagrams, charts, and other visual content. They benefit from seeing concepts represented graphically and often remember information better when it is visually presented. Key characteristics include a preference for color coding, mind maps, and infographics.

Auditory learners understand concepts best through listening and speaking. They enjoy discussions, lectures, podcasts, and audio recordings. This style is characterized by a strong ability to remember spoken information and a preference for verbal instructions. Auditory learners may also benefit from group discussions and verbal explanations.

Reading/writing learners enjoy in environments that involve reading and writing activities. They prefer traditional forms of information presentation, such as books, articles, and written assignments. This style is characterized by strong skills in reading comprehension and writing, and learners may benefit from taking detailed notes and summarizing information in written form.

Kinesthetic learners prefer hands-on experiences and learning through doing. They thrive in environments where they can engage in physical activities or experiments. This style is

characterized by a preference for practical applications, simulations, and interactive tasks, making it easier for them to grasp concepts through real-life experiences and tactile engagement.

2.2 Metacognitive learning styles

Description: This category focuses on how learners think about their learning, how they organise and reflect on information, and how they relate to new concepts and approaches to learning. Learners in this group differ in whether they prefer to be active, reflect on their learning, follow structured steps or perceive knowledge in a broader context.

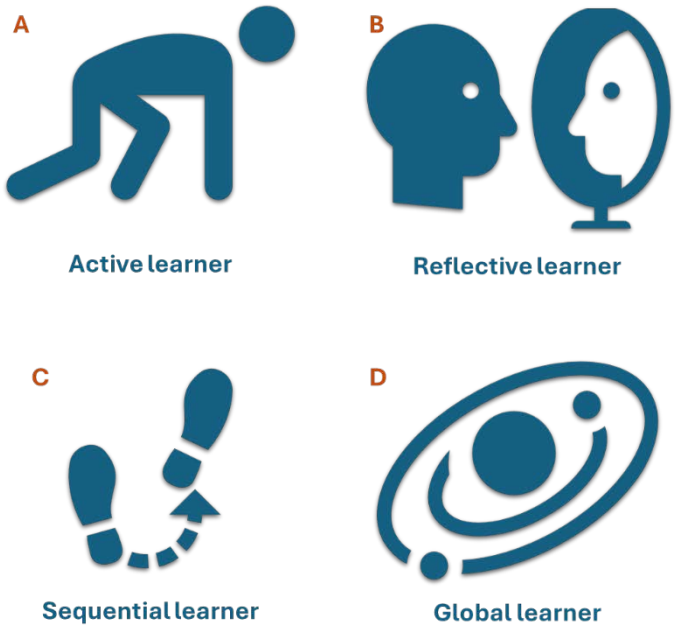

Figure 3. Metacognitive learning styles

Active learners prefer to engage with the material through hands-on activities and interactive experiences. They thrive on participation, discussion, and immediate feedback, often learning best when they can apply concepts in real-world scenarios. This style encourages collaboration and group work, as these learners find motivation and understanding through social interaction and dynamic environments.

Reflective learners take time to think and contemplate before acting. They prefer to process information internally, often analysing and synthesizing ideas before applying them. This style involves self-reflection and critical thinking, allowing learners to evaluate their understanding and performance. Reflective learners benefit from quiet environments where they can focus on their thoughts and review material at their own pace.

Sequential learners approach learning in a step-by-step manner, preferring a structured and organized process. They appreciate clear, logical sequences and find it easier to understand concepts when they build on each other. This style emphasizes following a systematic approach to problem-solving, often breaking down complex topics into manageable parts. Sequential learners thrive in environments where information is presented in a linear format.

Global learners tend to see the big picture and prefer to understand the overall concept before delving into details. They may struggle with linear information and often need context to fully grasp new ideas. This style encourages creative thinking and the integration of multiple perspectives, as global learners seek connections between various concepts. They benefit from summaries, overviews, and opportunities to relate new knowledge to prior experiences.

3 Analysis of the empathic questionnaire on students' learning styles

3.1 Survey participants

The chart below illustrates the distribution of 108 survey participants based on their current higher educational institution (HEI). The respondents are divided as follows:

- Jožef Stefan International Postgraduate School (Slovenia): 18.5%
- Norwegian University of Science and Technology (Norway): 25%
- Polytechnic University of Catalonia (Spain): 13.9%
- University of Lorraine (France): 27.8%
- Ghent University (Belgium): 14.8%

Most respondents are from the University of Lorraine (27.8%), followed by NTNU (25%). A slightly smaller proportion comes from the Polytechnic University of Catalonia (13.9%).

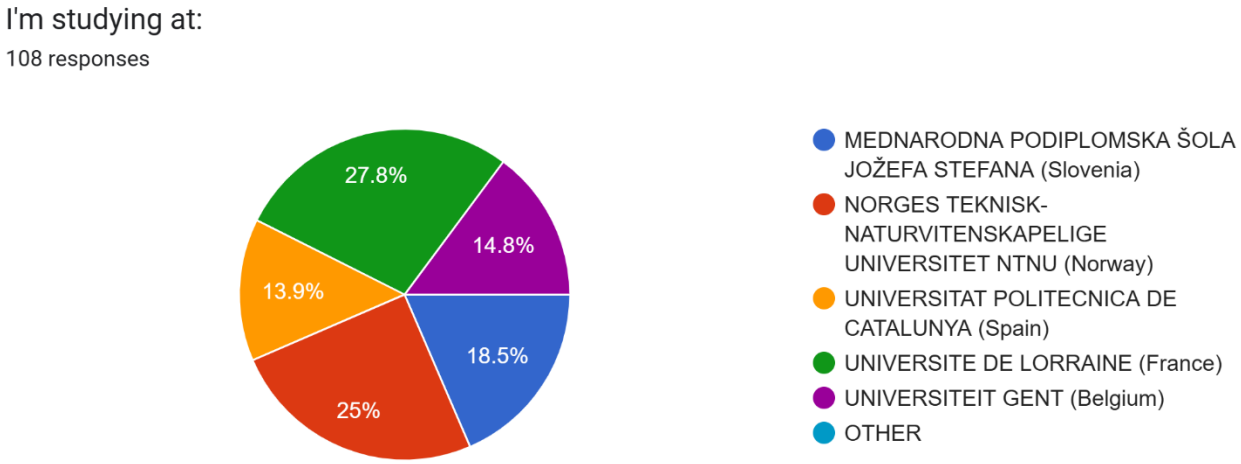

Figure 4. Distribution of survey participants by higher education institution

3.2 Cognitive learning styles among students

The chart in Figure 5 illustrates the preferred methods of receiving information among 108 survey participants. These insights are valuable for tailoring educational materials and approaches to the dominant learning styles. The key findings are:

1. **Visual** is the most preferred method, chosen by **47.2%** of participants, indicating that nearly half prefer receiving information through images, charts, or other visual representations.
2. **Written** is the second most popular method, selected by **26.9%** of participants, meaning a smaller group favours also receiving information in textual form.

3. **Hands-on** is preferred by **13.9%** of participants, showing a strong preference for learning through experience and practice
4. **Auditory** is the least popular method, chosen by only **12%** of participants, suggesting that fewer people prefer learning through listening.

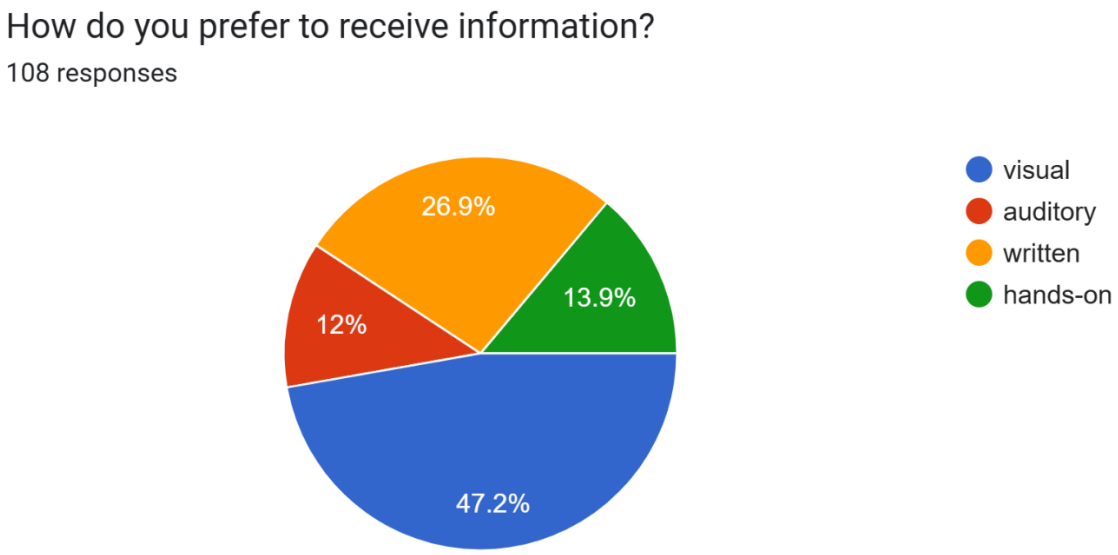

Figure 5. Preferred methods of receiving information among students

The chart in Figure 6 shows the results of how participants answered the question about what helps them most when learning something new. The survey received 108 responses, which are displayed in the form of a pie chart. The results are divided into four options:

1. **Diagrams, charts, or visual explanations** (blue): 33.3% of responses.
2. **Listening to an explanation or discussing the topic** (red): 21.3% of responses.
3. **Reading about the topic or writing notes** (orange): 16.7% of responses.
4. **Trying it out for myself and learning by doing** (green): 28.7% of responses.

The most popular learning method is **visual learning (diagrams and charts)**, while the least popular method is **reading and writing notes**. Similarly to Figure 5, Figure 6 highlights learning preferences specifically for acquiring new knowledge. In Figure 6, visual explanations (diagrams, charts, or similar) are the most popular choice, preferred by 33.3% of respondents. This aligns with the results from Figure 5, where 47.2% of participants favoured visual learning. Hands-on learning, chosen by 28.7% in Figure 6, also shows consistency with Figure 5, where 13.9% selected it as their preferred method, emphasizing the value of experiential approaches. Listening to explanations or discussions is chosen by 21.3%, while reading and writing notes is the least favoured method, with only 16.7% selecting it. Taken together, these findings emphasize that **visual and hands-on methods dominate as the most effective ways to both present and absorb information**. This suggests that educational materials and programs should prioritize these approaches while also integrating elements of auditory and textual methods to accommodate a wider range of learning styles.

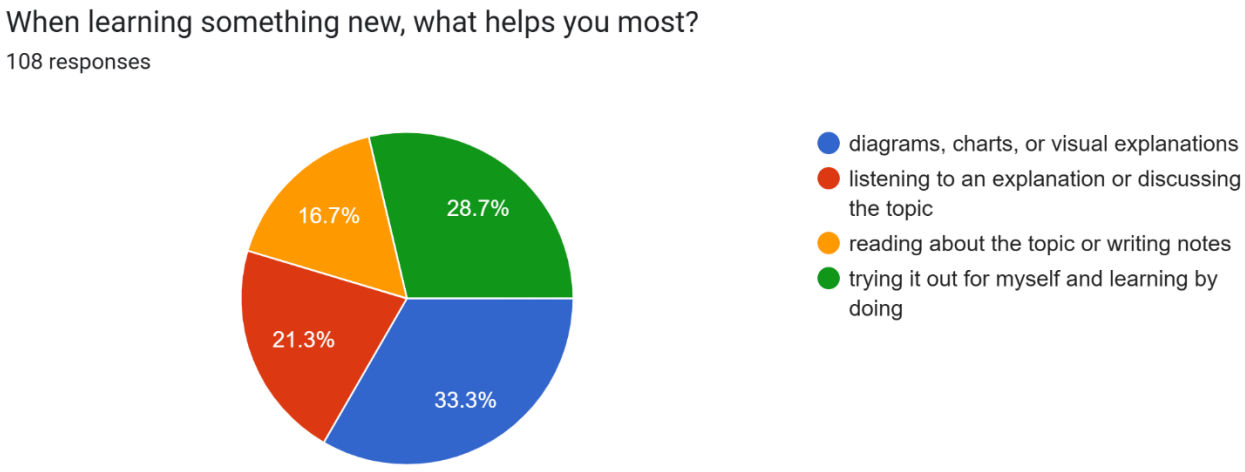

Figure 6. Preferred methods for learning new concepts among students

The chart in Figure 7 illustrates the primary factors that motivate 108 survey participants to engage with content. The largest proportion, 45.4%, indicated that **seeing how the content is relevant to their life or future goals** is the most significant motivator. This suggests that practical applicability and personal relevance are key drivers of engagement. The second most popular motivator, selected by 27.8%, is **getting hands-on experience or trying the content out themselves**, emphasizing the importance of experiential learning and active involvement.

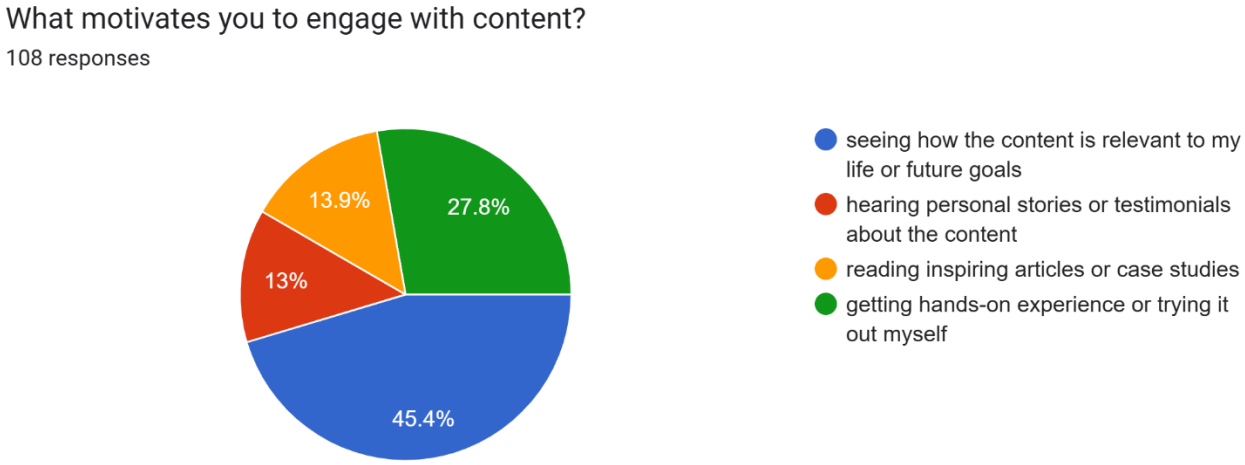

Figure 7. Key motivators for content engagement among survey participants.

Reading inspiring articles or case studies motivates 13.9% of participants, while **hearing personal stories or testimonials** was the least popular motivator, chosen by only 13%. This finding aligns with the results from Figure 5, where auditory learning was the least preferred style (12%), and Figure 6, where both reading and writing (16.7%) and listening to explanations or discussions (21.3%) were among the less favoured learning methods. Together, these results suggest that while inspirational content can motivate, it may be less

impactful when delivered through auditory or textual means for most participants. These results highlight the importance of aligning content with the personal goals of the audience and incorporating practical, hands-on elements to maximize engagement.

The chart in Figure 8 illustrates the responses of participants regarding when they feel most emotionally connected to content. The majority, 38.9%, indicated that they feel most connected when they can **try it out practically**, highlighting the significance of hands-on experiences in fostering emotional engagement. Following this, 25% of participants feel emotionally connected when they can **visualize the information**, underscoring the power of visual representations in creating an emotional bond with the content. Discussing the content with others is the third most significant factor, chosen by 24.1%, suggesting that **interpersonal interactions** contribute to emotional connection. Finally, only 12% of participants reported feeling most connected when they can read about it deeply, indicating that **textual engagement has the least emotional impact** for most individuals. This data suggests that traditional approaches to learning, which often rely heavily on reading and writing, may lack the emotional engagement necessary for deeper connection. On the other hand, innovative approaches that incorporate hands-on activities, interactive discussions, and visually rich content are more likely to foster emotional and cognitive engagement, particularly in online self-learning environments. For effective online learning design, incorporating practical and visual elements, along with opportunities for social interaction, should be prioritized to enhance both emotional connection and learning outcomes.

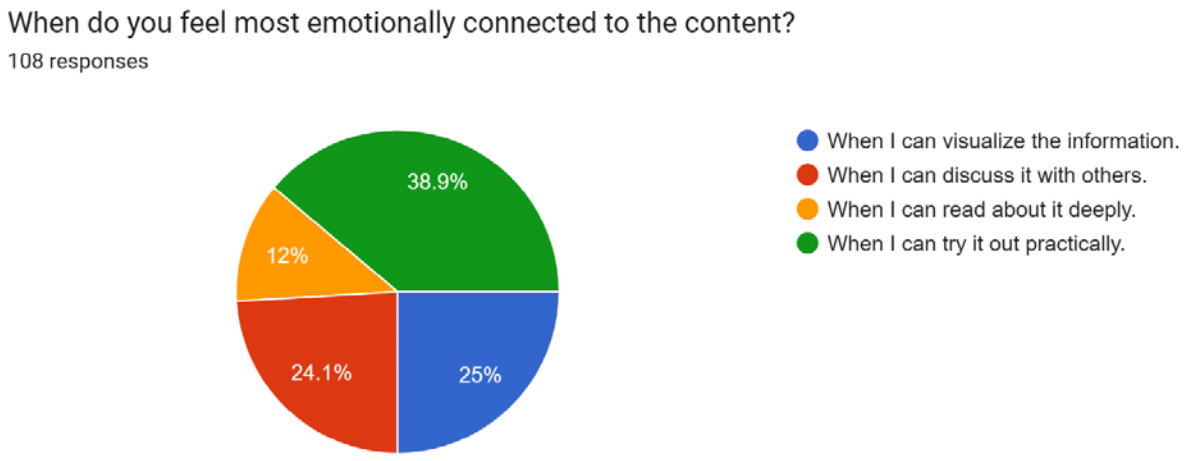

Figure 8. Factors that foster emotional connection to content

The chart in Figure 9 illustrates the preferred methods for understanding concepts related to sustainable innovations among students. The most popular method, chosen by 37%, is seeing infographics, videos, or diagrams, emphasizing the **importance of visual representations in understanding complex concepts**. The second most favoured approach, selected by 30.6%, is engaging in hands-on projects or experiments, highlighting **the value of experiential learning** when exploring sustainable innovations. Reading articles, research papers, or case studies was preferred by 20.4%, suggesting that a smaller but notable group relies on detailed textual content for understanding. The least popular method, chosen by only 12%, is listening

to podcasts, discussions, or presentations, indicating that **auditory learning is less effective** for most participants in this context. These findings suggest that a combination of visual aids and practical experiences should be prioritized when designing educational content about sustainable innovations. Additionally, the integration of short video modules in the form of e.g. nanolearning offers a highly effective way to convey complex concepts quickly and engagingly, combining visual elements with concise and focused learning opportunities. This approach can complement hands-on and visual methods while catering to the fast-paced learning preferences of modern students. Based on the results of our research, methods such as visual tools (infographics, videos, and diagrams) and hands-on projects are the most suitable for teaching and learning sustainable innovations, as they enhance understanding and engagement. On the other hand, auditory methods, such as podcasts or presentations, appear to be less effective, making them less ideal for conveying these concepts. Textual methods, while not as effective as visual and experiential approaches, can still play a supporting role for learners who prefer detailed and in-depth content.

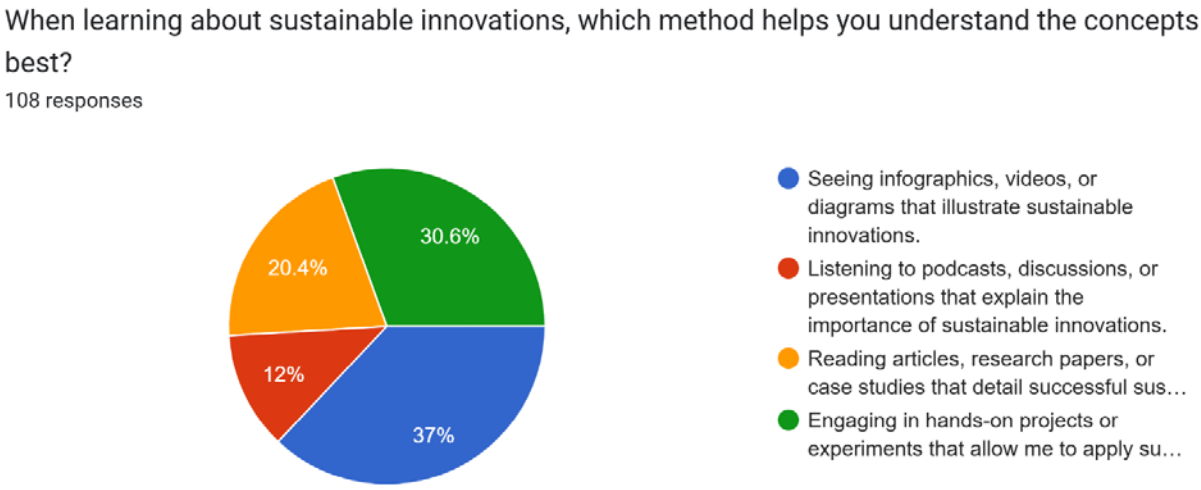

Figure 9. Preferred learning methods for understanding sustainable innovations

The chart in Figure 10 illustrates the effectiveness of various methods in exploring entrepreneurial innovation to tackle complex social challenges, based on responses from survey participants. The most preferred method, chosen by 32.4%, is listening to expert panels or podcasts, emphasizing the **value of auditory learning and real-world examples** in understanding entrepreneurial approaches to social problems. The second most favoured approach, selected by 26.9%, is participating in **collaborative workshops or innovation labs**, highlighting the importance of hands-on, interactive learning and peer engagement. Using visual aids, such as infographics or concept maps, is preferred by 25%, showcasing the significance of visual representations in understanding innovative solutions and frameworks. Lastly, 15.7% of participants find reading case studies, research reports, or journal articles most effective, indicating that **textual analysis is the least popular method** in this context.

Interestingly, these results are the opposite of those observed for sustainable innovation, where visual and practical methods were most effective, and auditory approaches were less favoured. This contrast can be attributed to the nature of entrepreneurial innovation, which

is more deeply connected to real-world experiences, economic contexts, and financial considerations. Entrepreneurship often relies on the ability to draw from lived experiences, understand market dynamics, and navigate social and financial challenges. Listening to expert panels or podcasts provides access to firsthand knowledge and practical advice from experienced professionals, which is highly relevant for aspiring entrepreneurs. Moreover, workshops and collaborative activities align with the entrepreneurial focus on networking, teamwork, and problem-solving in dynamic settings. In contrast, sustainable innovation, which often involves exploring environmental and technical challenges, benefits more from visual aids and experiential learning tailored to understanding systems and processes. These findings suggest that a **blend of auditory, visual, and interactive approaches is key to effectively exploring entrepreneurial innovation and addressing social challenges**.

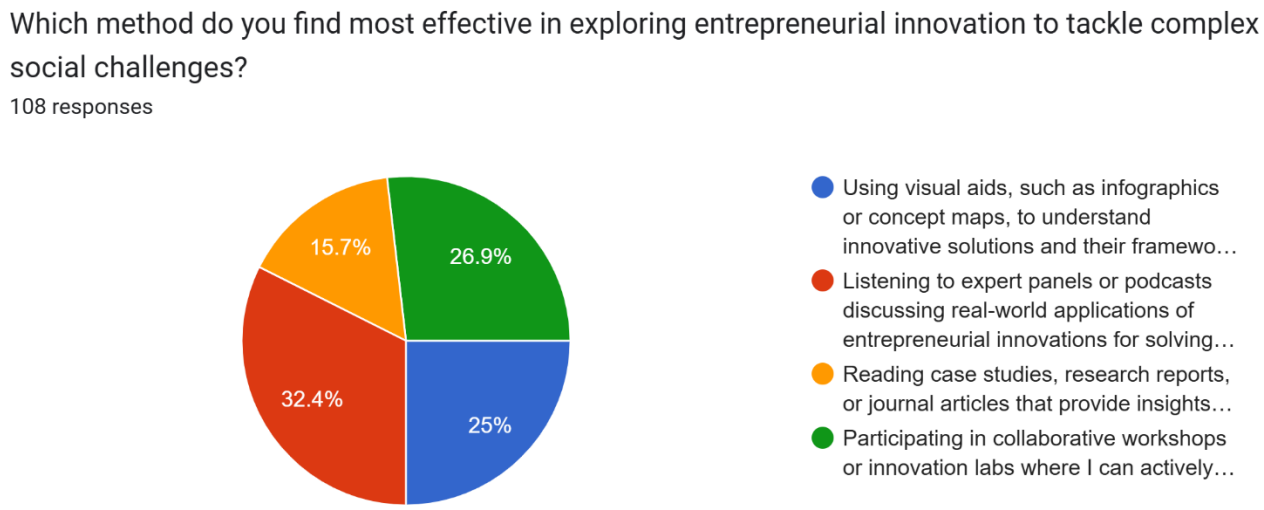

Figure 10. Preferred learning methods for exploring entrepreneurial innovation

Dominant cognitive learning style

Visual learning emerged as the dominant cognitive learning style in this study. Nearly half of the participants (47.2%) preferred visual methods such as diagrams, charts, and infographics for processing information, while 33.3% highlighted diagrams and charts as the most helpful when learning something new. This preference underscores the importance of clarity, organization, and the ability to grasp complex ideas quickly through graphical representation. Visual learning simplifies complex topics, reduces cognitive load, and enhances retention through mental imagery. Furthermore, our study demonstrates that the choice of learning style and approach also depends significantly on the subject issue being addressed. For example, sustainable innovation benefits from visual and practical methods that focus on understanding environmental systems and processes. In contrast, entrepreneurial innovation places greater emphasis on auditory and experiential approaches, as it is more closely tied to real-world experiences, economic dynamics, and financial considerations. This distinction highlights the importance of tailoring educational approaches to the specific characteristics and demands of the topic being explored.

3.3 Metacognitive learning styles among students

The chart in Figure 11 illustrates participants' preferences for approaches that help them understand and remember new material, reflecting different metacognitive learning styles. Among 108 participants, the largest proportion (32.4%) prefers **breaking down complicated topics into smaller, simpler steps**, indicating that **step-by-step learning** is the most effective method for many learners. The second most preferred approach, chosen by 31.5%, involves **taking time to reflect on the material**, highlighting the importance of self-reflection and processing in learning. In addition to self-reflection, self-assessment plays a crucial role in effective learning. This can be achieved through short tests and tracking the development of competencies before and after a lecture or workshop. Such methods enable learners to evaluate their progress, identify gaps in understanding, and reinforce their learning outcomes, making the process more structured and impactful.

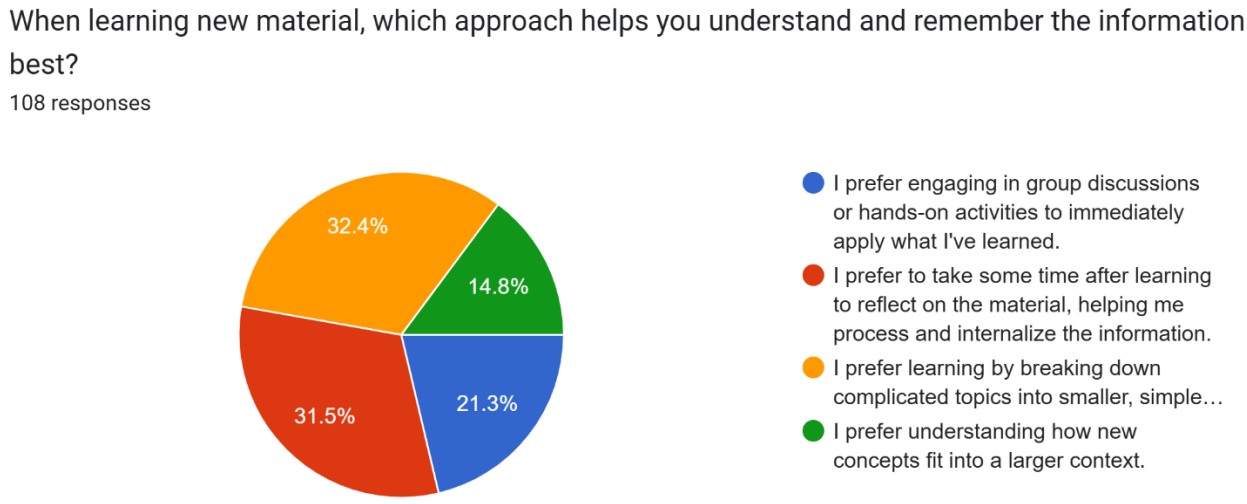

Figure 11. Preferred approaches for understanding and retaining new material

Engaging in group discussions or hands-on activities was preferred by 21.3%, showing that some learners benefit from active application and collaboration. Lastly, 14.8% of participants favour **understanding how new concepts fit into a larger context**, suggesting that fewer learners prioritize a broader conceptual framework as their primary strategy. These findings emphasize the diversity in metacognitive learning styles and the need to incorporate various approaches in educational settings to accommodate different learner preferences. The lower preference for "understanding how new concepts fit into a larger context" could stem from the fact that this approach requires broader knowledge, general awareness, and a deeper background of understanding, which learners develop over time through education and experience. Without a solid foundation of interdisciplinary knowledge and the ability to connect concepts across different domains, it can be challenging for learners to prioritize this strategy. This highlights the importance of fostering critical thinking, interdisciplinary learning, and broader contextual awareness throughout education to support this metacognitive approach.

The chart in Figure 12 illustrates the preferences of respondents regarding the speed of content delivery during learning. The most preferred approach, chosen by 43.5% of participants, is a **structured speed**, where each concept is clearly explained before moving on to the next. This preference indicates the importance of clarity and **step-by-step explanations** for a large proportion of learners. A notable 24.1% enjoy a **faster speed**, which provides an overview first, followed by detailed connections to the bigger picture, emphasizing a need for a high-level understanding before diving into specifics. Another 24.1% prefer a **moderate speed**, allowing time to reflect and process the material as it is introduced. Interactive tasks and self-evaluation by short tests play a crucial role in this preference for moderate speed, as they provide learners with opportunities to engage actively with the content and assess their understanding. These methods help learners consolidate new knowledge while reflecting on its relevance, ensuring deeper comprehension and retention. Lastly, 8.3% favour content being delivered quickly so they can **jump into discussions and immediately apply what they've learned**, suggesting a preference for fast-paced and action-oriented learning. These results highlight the diversity in preferred content delivery speeds, suggesting that a one-size-fits-all approach may not be effective for all learners. A combination of approaches can be employed, such as starting with a global overview to provide context, using step-by-step learning with smaller units for clarity, and concluding with reflective learning to solidify understanding and encourage critical thinking.

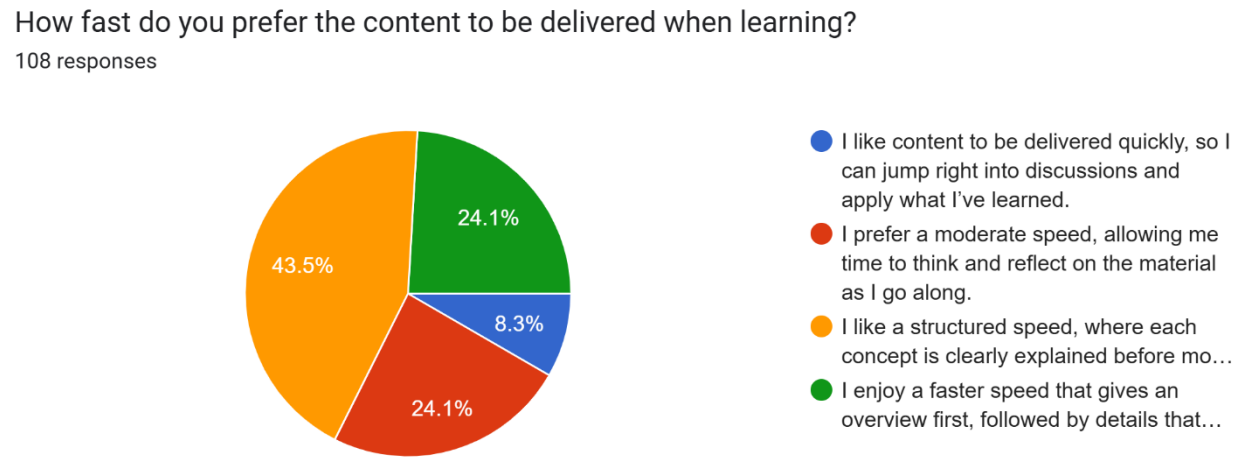

Figure 12. Learners' preferences for speed of content delivery

The last chart in Figure 13 highlights the preferences of respondents on how they like to use digital technology and social media, such as short videos, for learning. Most respondents (34.3%) prefer videos that **break down concepts into clear, sequential steps**, making the content easier to follow and understand. A significant portion (26.9%) enjoys videos that **provide a quick overview first**, followed by detailed explanations, which helps them grasp the bigger picture and connect new information to existing knowledge. Another 25.9% prefer videos with **interactive quizzes or questions throughout**, keeping them engaged and facilitating real-time application of the material. Lastly, 13% prefer watching videos at a **slower pace**, allowing them to pause, reflect, and take notes as they learn. This distribution indicates that **learners value structured, clear, and interactive content delivery when using digital media for education**.

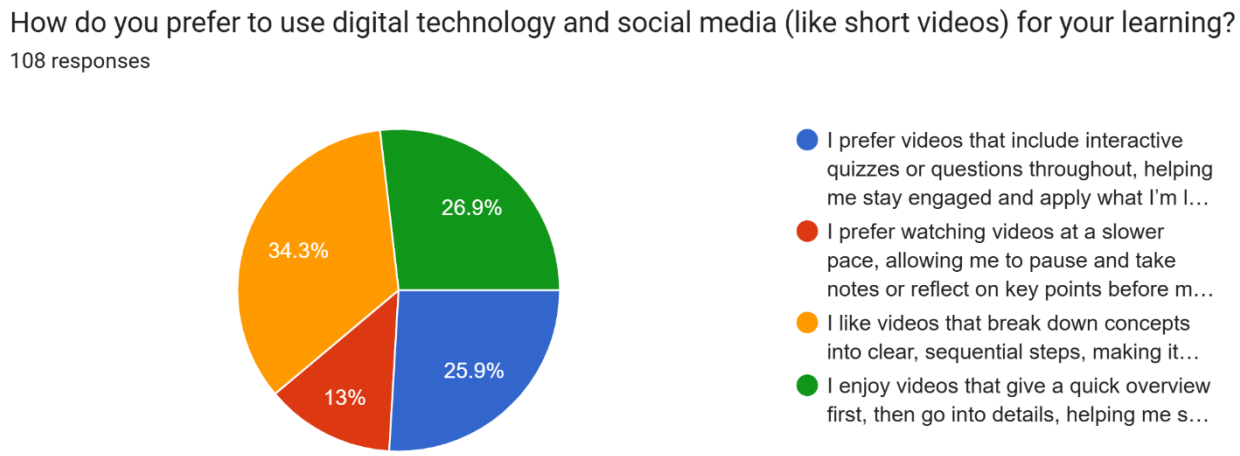

Figure 13. Preferred use of digital media and social videos for learning

Dominant metacognitive learning styles

Sequential learning is the dominant metacognitive style in this study. The study shows that 32.4% of participants preferred breaking down topics into smaller, simpler steps, and 34.3% liked videos with clear, sequential steps. This style aligns with a structured and logical approach to understanding and remembering new material, emphasizing step-by-step progression. Sequential learning appeals to the need for organization and linearity, making complex information more manageable and easier to process. Sequential learning ensures clarity and focus, helping learners progress logically and build knowledge step by step. It aligns with learners' need for organization and incremental understanding, which reduces overwhelm when processing complex topics. This dominance highlights the importance of providing well-structured content to enhance comprehension and retention.

3.4 Differences in students' learning styles between participating countries

Understanding the differences in learning preferences across countries is crucial when designing educational content for platforms like YouTube and TikTok. These platforms are increasingly used for learning, especially among younger generations, and their global reach means that content must resonate with diverse audiences. Cultural and educational contexts shape how students engage with learning materials. Adapting content to these preferences ensures greater effectiveness, engagement, and accessibility of learning. For instance, while some cultures prioritize structured, step-by-step explanations, others may value hands-on learning or interactive elements. By tailoring educational strategies to these preferences, educators and content creators can create impactful resources that resonate globally, fostering deeper learning and understanding.

The graph in Figure 14 illustrates the proportion of students with different learning styles (auditory, hands-on, visual, and written) across five countries: Belgium, France, Spain, Norway, and Slovenia. The percentages for each learning style are represented by the coloured segments in each bar, providing insights into the preferred learning methods

within each country. The numbers in each coloured segment of the column show the number of students who selected a particular answer in the survey. Visual learning is the most prominent style overall. In all countries, except Spain, the visual learning style (yellow) represents the largest proportion of students, with the highest percentage seen in Norway, France and Slovenia. Students in Belgium and Spain show a notable preference for written learning (green), while this style is less prevalent in Slovenia. Only a small proportion of students prefer hands-on learning (red colour). Auditory learning is consistently low across all countries, even with no answer in Norway. However, in Spain, this learning style is somewhat more preferred, indicating that cultural or contextual factors may play a role in shaping preferences for auditory methods. The dominance of visual and written learning styles indicates a strong preference for methods involving reading, observing, and structured information across countries. The variability in the distribution highlights cultural or educational differences that may influence how students develop their learning preferences.

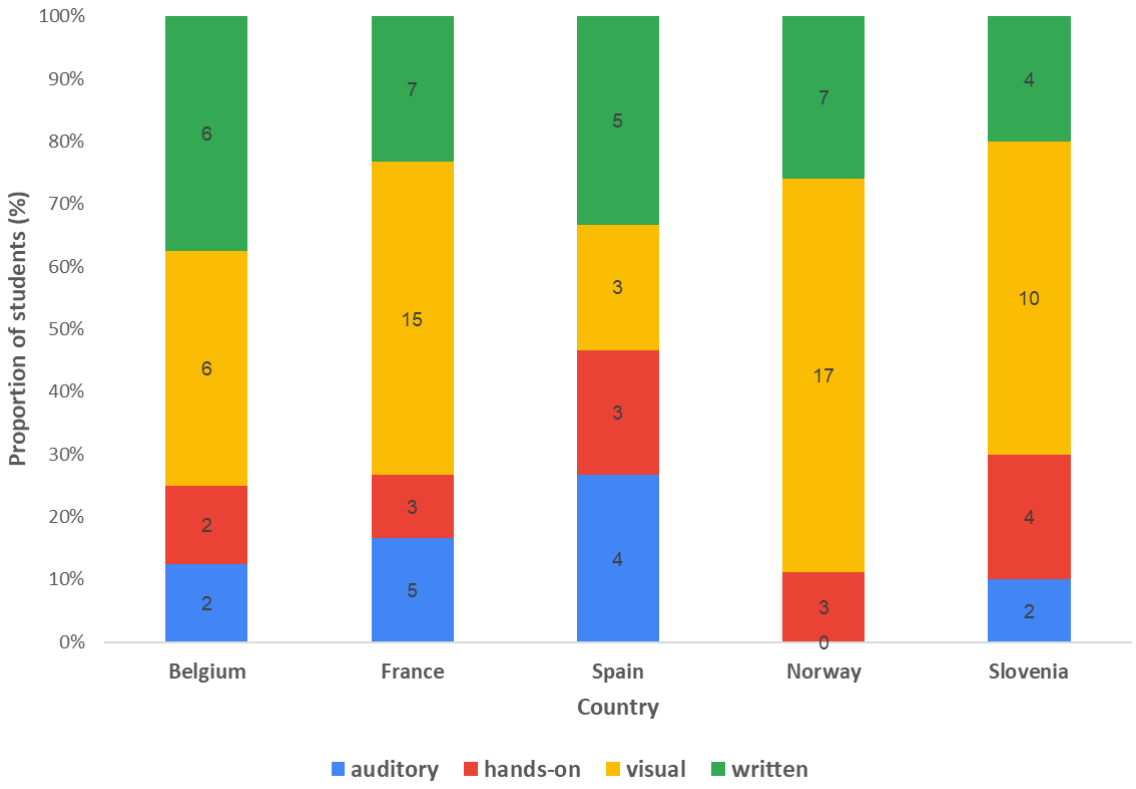

Figure 14. Distribution of learning styles among students by participating country

The next graph in Figure 15 shows the proportion of students across all five countries based on their preferred methods of emotional connection to learning content. The preferences are grouped into four categories:

1. When I can discuss it with others (blue)
2. When I can try it out practically (yellow)
3. When I can read about it deeply (red)
4. When I can visualize the information (green)

Students in Norway and Belgium feel the strongest emotional connection when they can visualize the information, indicating a preference for imagery and visual aids in learning. France, Spain and Slovenia show the highest percentages of students who emotionally connect when they can try out the material practically. This suggests a preference for experiential and hands-on learning in these countries. A notable proportion of students in Norway and France connect emotionally through discussions, highlighting the importance of collaborative and social learning experiences. Very few students prefer emotionally connecting through deep reading, with the highest percentage in Belgium, and almost negligible in Spain and Norway. Practical application and visualization are the two most preferred ways for students to feel emotionally connected to learning content across countries.

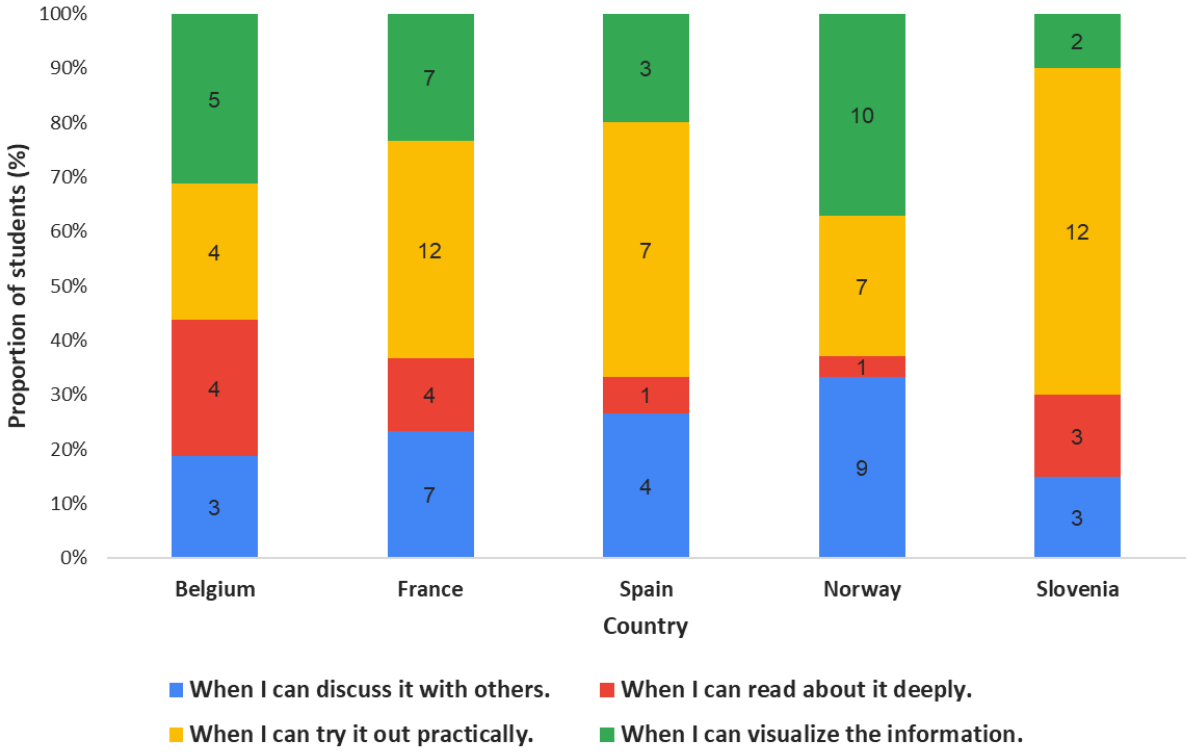

Figure 15. Emotional connection to learning content by preferred method and country

These preferences suggest the importance of engaging, hands-on tasks and visually appealing materials. Discussion-based learning plays a significant role, especially in Norway and France, where students value group interactions as a means of emotional connection. Deep reading is consistently low, indicating that written content alone is less effective in fostering an emotional bond with learning material. To emotionally engage students across diverse cultural contexts, educational resources should emphasize hands-on activities, visual aids, and opportunities for discussion and collaboration, while using deep reading sparingly as a supplementary tool.

The following graph in Figure 16 shows the preferred learning methods for understanding sustainable innovations among students from different countries. The numbers on the

columns represent the actual count of student responses for each category in each country. The methods are categorized as follows:

1. Seeing infographics, videos, or diagrams (green).
2. Reading articles, research papers, or case studies (yellow).
3. Listening to podcasts, discussions, or presentations (red).
4. Engaging in hands-on projects or experiments (blue).

For Belgian students, the preference for hands-on projects (blue, 5) and visual aids (green, 5) is evenly distributed. Fewer students chose reading articles (yellow, 4) or listening to audio-based content (red, 2). In France, visual aids (green, 10) are the most preferred, followed by reading articles (yellow, 8). Hands-on projects (blue, 9) are also popular, while listening to audio content is less favored (red, 3). In Spain, hands-on methods (blue, 5) and visual aids (green, 6) are almost equally preferred. Reading articles (yellow, 3) is less popular, with podcasts and discussions (red, 1) receiving minimal interest. Norwegian students strongly prefer visual aids (green, 13), significantly more than any other method. Hands-on projects (blue, 7) and audio-based content (red, 5) are moderately chosen, while reading articles is the least selected (yellow, 2). In Slovenia visual aids (green, 6) and hands-on projects (blue, 7) are almost equally significant. Articles (yellow, 5) are moderately chosen, and audio content (red, 2) is less favored.

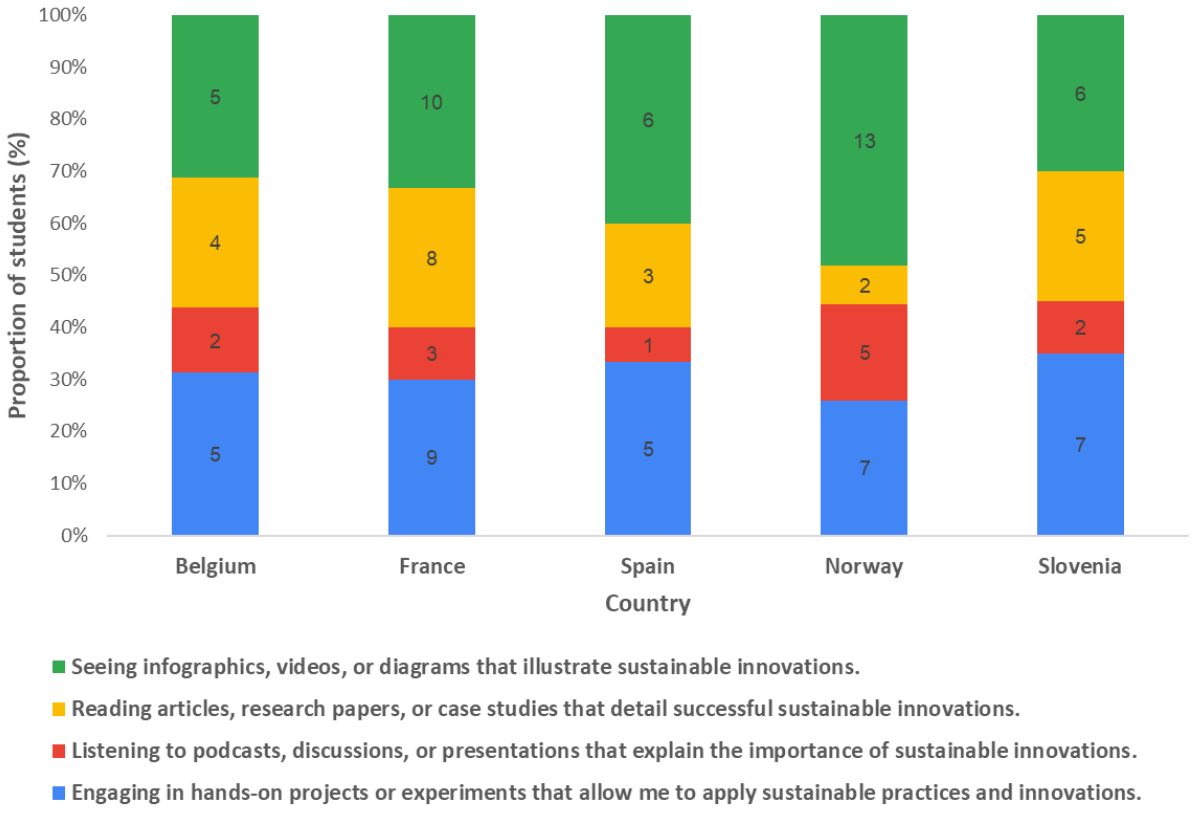

Figure 16. Preferred learning methods for understanding sustainable innovations among students by country

Visual aids (green) are consistently among the top preferences across all countries, particularly in Norway, Spain and France. Hands-on projects (blue) are highly favoured,

especially in France, Spain and Slovenia, indicating the importance of practical engagement in learning about sustainable innovations. Listening to podcasts and discussions (red) is the least chosen method across all countries, suggesting this mode of learning is less effective for students in this context. Reading articles and case studies (yellow) is moderately popular but generally ranks below visual and hands-on methods. This data suggests that incorporating interactive visuals and practical, hands-on experiences would be the most effective strategies for designing educational content about sustainable innovations for international audiences.

The graph in Figure 17 illustrates the preferred learning methods for exploring entrepreneurial innovation among students from five countries. The numbers within the columns indicate the actual count of student responses for each category in each country. The responses are categorized into four methods, represented by different colours:

- Green: Using visual aids (e.g., infographics or concept maps) to understand innovative solutions and their frameworks.
- Yellow: Reading case studies, research reports, or journal articles that provide insights into successful entrepreneurial strategies.
- Red: Participating in collaborative workshops or innovation labs for active problem-solving with peers.
- Blue: Listening to expert panels or podcasts discussing real-world applications of entrepreneurial innovations for solving environmental challenges.

Belgian students value visual methods and listening to expert discussions in the context of entrepreneurial innovation. Case studies (4 responses) are slightly less popular, while workshops (2 responses) are the least favoured. The most preferred method in France is podcast (10 responses). Both visual aids and case studies are equally popular (7 responses each), while workshops (3 responses) are the least favoured. Spanish students prefer practical and visual methods, while reading case studies does not appeal to them at all. Workshops (6 responses) and visual aids (6 responses) are equally favoured, while podcasts (3 responses) are moderately preferred. Norwegian students have a strong preference for hands-on and interactive learning, with less interest in traditional reading materials. Most students favour podcasts (12 responses), followed by workshops (7 responses). Visual aids (6 responses) are moderately preferred, while case studies (2 responses) are the least favoured. Slovenian students have a balanced preference for most methods, with workshops slightly leading. However, visual aids are less appealing.

Workshops (red) are popular learning method overall, particularly in Spain and Norway, highlighting the importance of interactive, hands-on approaches. Visual aids (green) are favoured in Belgium and Spain but are less popular in Slovenia. Podcasts (blue) are notably popular in France and Norway but are less preferred in Spain. Case studies (yellow) are the least popular overall, except in Slovenia, where they are moderately appreciated.

The graph reveals that students generally prefer interactive and practical learning methods, such as workshops, across most countries. Traditional approaches like reading case studies or journal articles are less attractive, particularly in Spain and Norway, suggesting the need for more engaging or innovative approaches to appeal to students. The data also reflects regional

preferences, with visual and auditory methods (e.g., podcasts) varying in popularity across countries. Educational programs aimed at fostering entrepreneurial innovation should focus on interactive workshops and visual tools to actively engage students. While podcasts have potential, traditional reading materials might need to be supplemented with more engaging formats to appeal to students across all countries.

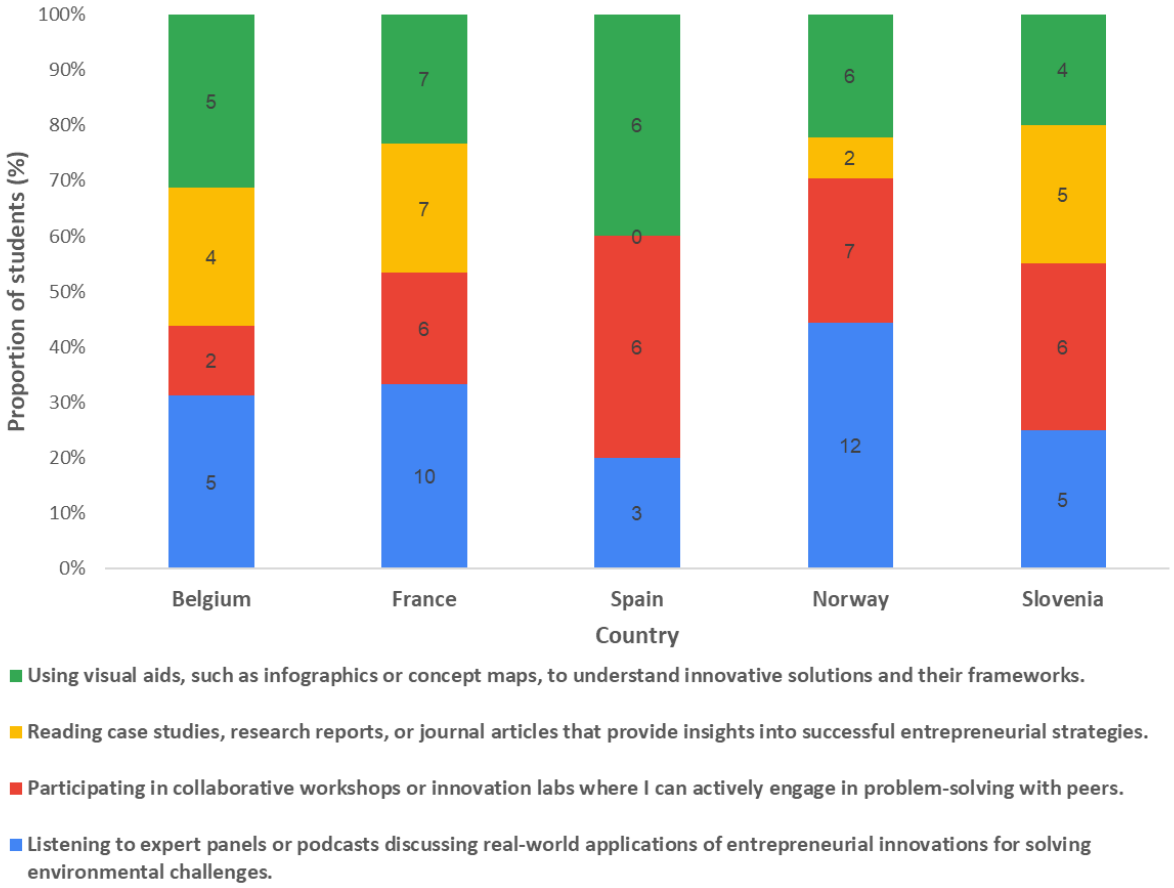

Figure 17. Preferred learning methods for exploring entrepreneurial innovation among students by country

The next graph illustrates the preferred approaches students from Belgium, France, Spain, Norway, and Slovenia use for understanding and retaining new material. Each bar represents a country, with different coloured segments showing the number of students who prefer specific learning methods. Green approach “understanding the larger context” is less popular overall, with only a small number of students selecting it, particularly in Belgium (1) and Slovenia (2). In contrast, France (6) and Norway (4) show a slightly stronger preference for this method. Yellow approach “reflection and internalization” is the first and the second most chosen method in most countries. France has the highest number of students (11) preferring this approach, while Belgium and Spain have 4 each. Red approach “breaking down complex topics” is the most widely preferred approach across most countries, with a significant number of students in every country selecting it. Belgium (8), France (7), Spain (4), Norway (8), and Slovenia (8) show strong preferences for this method, emphasizing its universal appeal. Blue approach meaning group discussions or hands-on activities is moderately

popular, with 6 students in France and Norway preferring it, while Belgium, Spain, and Slovenia each have 3 or 4 students selecting this approach.

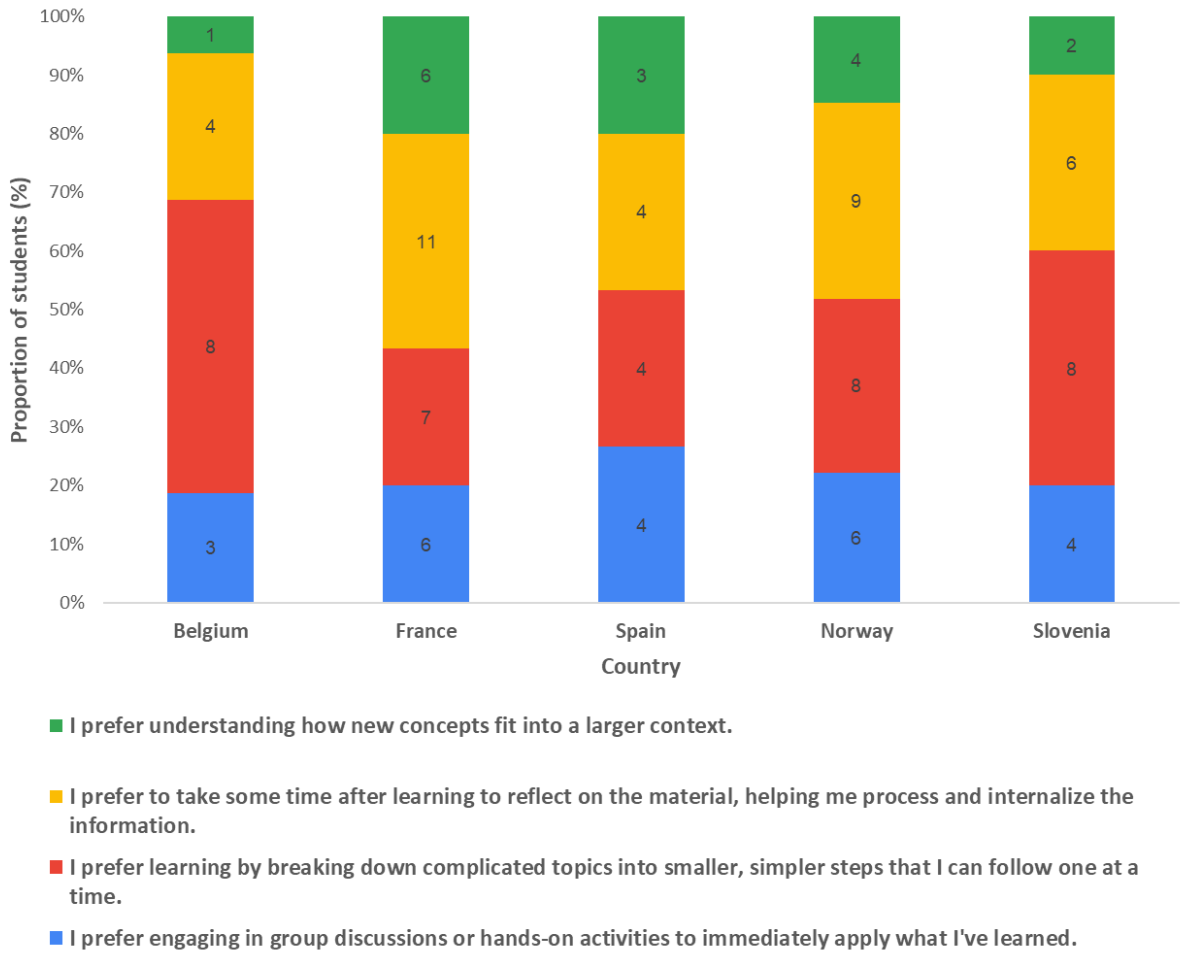

Figure 18. Preferred approaches for understanding and retaining new material among students from different countries

The data suggests that breaking down complicated topics into smaller, simpler steps (red) is the most universally preferred approach among students across all five countries. Reflection and internalization (yellow) are also valued, especially in France. Hands-on activities and group discussions (blue) and understanding the broader context (green) are less favoured overall but still hold importance for specific groups of students, depending on the country. This variation highlights the diversity in learning styles and preferences across different cultural and educational contexts.

Figure 19 depicts the preferences of students from Belgium, France, Spain, Norway, and Slovenia regarding the speed at which educational content is delivered. The vertical bars represent the number of students in each country who prefer specific approaches, with different colours corresponding to various delivery speeds. Moderate speed with time to reflect (green) is most common preference in Belgium (8). France (5) and Slovenia (3) show lower numbers, suggesting less interest in this approach in those countries. Quick delivery for immediate application (yellow) is the least popular approach overall. Only a small number of students from France (3), Norway (1) and Slovenia (2) prefer this speed, while Belgium show

no students choosing this option. Structured speed with clear explanations (red) dominates most countries, indicating a strong preference for structured, clearly explained content. France (13), Norway (12), Slovenia (8), and Belgium (8) exhibit high preferences for this method, while Spain shows moderate interest with 6 students. Faster-paced learning that starts with an overview followed by details (blue) is moderately popular, especially in Slovenia, France and Norway. Spain (2) shows varying degrees of preference, with Belgium showing no interest in this method.

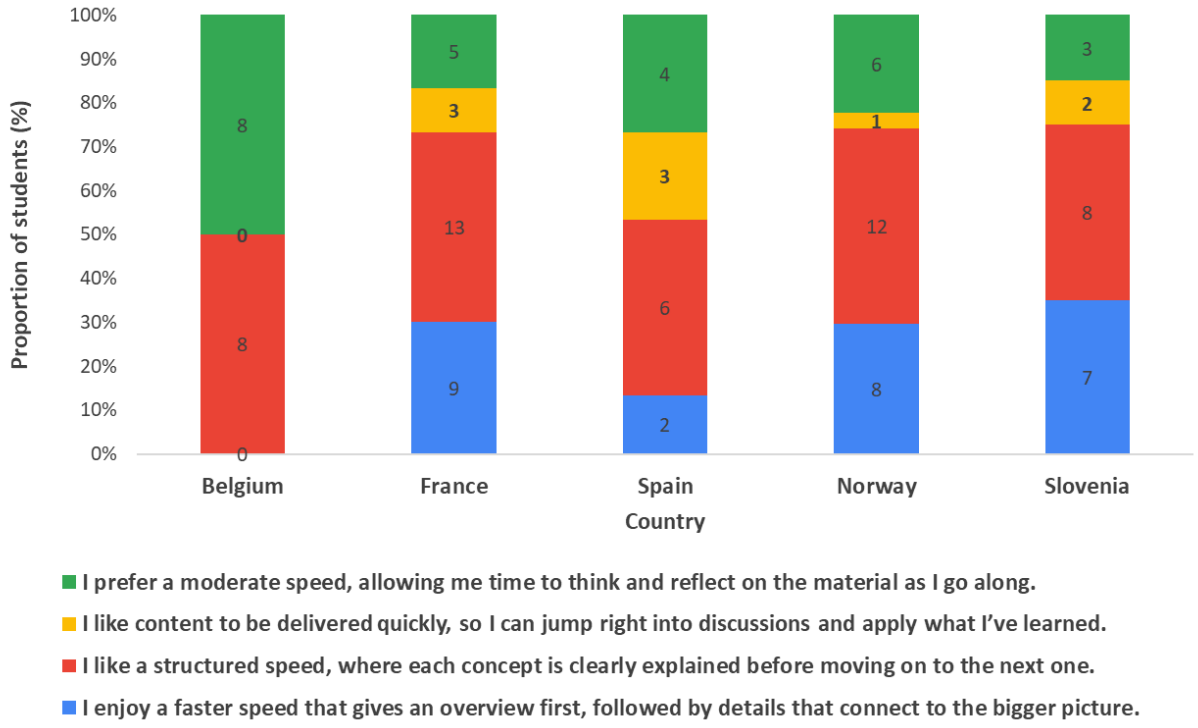

Figure 19. Learners' preferences for speed of content delivery among students from different countries

The data reveals that a structured speed with clear explanations (red) is the most preferred content delivery style across all countries, reflecting a common desire for clarity and logical progression. A moderate speed allowing time for reflection (green) is the second most popular approach, particularly in Belgium, Spain and Norway. Faster-paced learning with overviews (blue) appeals to some students, especially in France and Slovenia, while quick delivery for immediate application (yellow) is the least preferred option across all countries. This indicates a strong global preference for thorough, methodical teaching styles, with variations in secondary preferences depending on the country.

The last graph in Figure 20 illustrates the preferences of students from participating countries regarding the use of digital media and videos for learning. The vertical bars represent the number of students in each country who prefer specific styles of video-based learning, with different colours indicating different approaches. Green preference (slower pace with time to pause and reflect) is consistent but not highly popular across countries, showing similar numbers. Videos incorporating interactive quizzes or questions (yellow) are most preferred by students in France (9). Norway, Spain and Slovenia show moderate interest. Red approach

(clear, sequential steps) is a leading choice for students in France (10), Norway (10), and Slovenia (9). Spain (3) and Belgium (5) exhibit a slightly lower preference, though it is still significant. Videos that provide an overview first and then go into detail (blue) are particularly preferred in Norway (9) and France (9). Spain (3), Slovenia (4), and Belgium (4) show less interest in this approach.

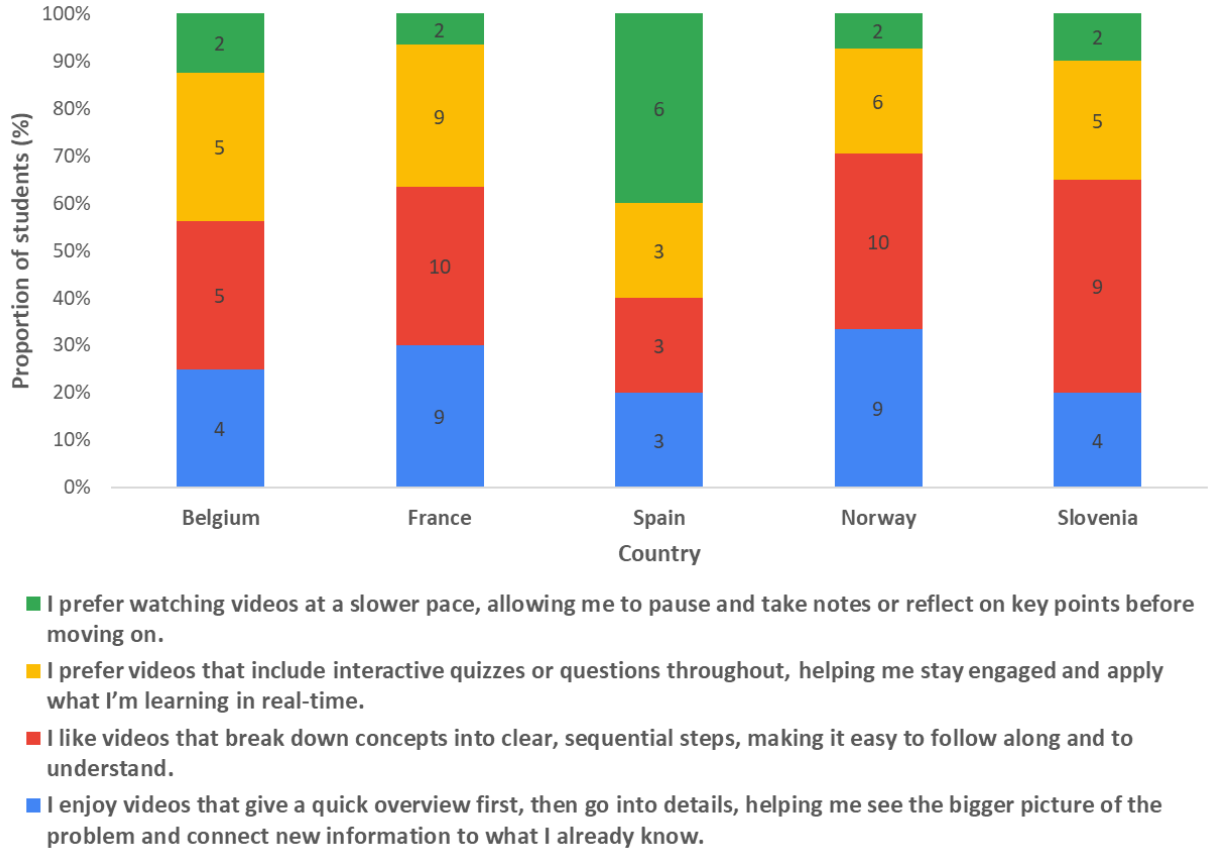

Figure 20. Preferred use of digital media and social videos for learning among students from different countries

The data highlights that videos breaking down concepts into clear, sequential steps (red) are the most favoured approach across several countries, particularly in Spain, Norway, and Slovenia. Interactive videos with quizzes (yellow) and videos offering a quick overview followed by details (blue) are also quite popular in most regions, reflecting an emphasis on engagement and structured content delivery. On the other hand, videos presented at a slower pace (green) have consistently lower appeal across all surveyed countries except Spain. This indicates a preference for dynamic, interactive, and well-structured video content for learning purposes.

Dominant learning styles in participating countries

Belgium: Belgian students demonstrate a balanced preference for visual learning and written content, reflecting a structured, academic approach rooted in the country's strong emphasis on traditional education. They also value clarity and methodical progression, which is evident in their preference for breaking down complex topics and structured video explanations.

Belgian learners tend not to prefer contextual breadth, focusing more on reading and less on discussions, suggesting a stronger inclination toward individual study rather than collaborative exploration. They are predominantly visual and writing-oriented learners who prefer step-by-step learning, breaking content into smaller, manageable units for better understanding. Additionally, they are less receptive to fast-paced content delivery. The lower preference for interactive or hands-on methods may indicate a cultural inclination toward formal, theory-driven education.

France: French students favour hands-on learning, collaborative workshops, and reflection. This aligns with the country's tradition of interactive and discussion-oriented education, often seen in its emphasis on group work and practical applications in schools. Their preference for structured video content and moderate interest in visual aids suggests a balance between traditional academic rigor and the need for innovative, experiential approaches. French learners place significant emphasis on reflection in their learning process, valuing the opportunity to deeply process and analyse new material. Additionally, there is a strong focus on interactive tasks, highlighting the importance of active engagement and practical application in their educational experience.

Spain: Spanish students stand out with a strong preference for interactive quizzes and clear, sequential video explanations. They exhibit a strong hands-on learning style and a notable preference for workshops, reflecting their inclination towards practical, experiential learning. Among all groups, they demonstrate the most pronounced interest in auditory learning, favouring listening to explanations or engaging in discussions. However, they show less interest in deep reading, preferring auditory or conversational approaches instead. Additionally, Spanish learners appreciate slower-paced videos for learning, as this allows them to pause and take notes, ensuring they can process and retain key information effectively. This may be tied to the Spanish educational system's growing focus on engagement and active participation in learning, as well as a cultural emphasis on dynamic and interactive communication.

Norway: Norwegian students show a marked preference for visual learning and structured explanations, reflecting the country's progressive, student-centred education system that emphasizes clarity and accessibility. Their high interest in hands-on projects and workshops aligns with Norway's practical, application-oriented approach to education. The relatively low preference for deep reading or slower-paced content suggests a cultural emphasis on efficiency and active learning. Norwegian learners prefer a balanced pace of content delivery—not too fast nor too slow—indicating that they value clarity and engagement without unnecessary delays or rush. While they are less inclined towards reading, they are more open to listening and engaging in discussions, although auditory learning is still among the least favoured styles. The visual learning style clearly stands out as the dominant preference, reflecting their reliance on clear and organized visual aids to understand and process information.

Slovenia: Slovenian students exhibit a balanced preference for hands-on methods and visual aids, highlighting the importance of experiential and visually engaging content. The cultural context here reflects an education system that values innovation and practical application.

Their preference for breaking down complex topics indicates a need for structured, step-by-step guidance, aligning with the country's focus on systematic learning approaches. Hands-on learning strongly dominates among Slovenian students, showcasing their reliance on practical, experiential methods. Visual learning, while present, is somewhat less prominent compared to other groups, indicating that visual aids play a supporting rather than a leading role. Auditory learning, however, is poorly represented, suggesting that listening-based methods are among the least preferred by Slovenian learners.

The IGNITE analysis reveals that while visual aids and structured explanations are universally appreciated, there are clear cultural differences in how students prefer to learn. Countries like France and Norway emphasize collaborative, hands-on learning, whereas Belgium and Spain lean more toward structured and interactive formats. Slovenia, with its balanced preferences, showcases the value of integrating multiple methods to cater to diverse needs. Recognizing these cultural nuances is essential for creating effective educational content that resonates with international audiences on worldwide platforms like YouTube and TikTok.

3.5 Suggestions for short video design for nanomodules

- **Segmented, modular videos**: Divide the video into clear sections with timestamps (e.g., overview, step-by-step explanation, practical examples). This format appeals to sequential learners who prefer structured content. Design each nanomodule as a series of 3–5 short videos, with each video covering a distinct subtopic or concept. Begin with an overview video to introduce the topic and its relevance, followed by step-by-step explanation videos, and conclude with an application or reflection video. This format appeals to sequential learners, ensures thorough coverage of competencies, and allows learners to consume content at their own pace.
- **Quick overviews with visuals**: Start with a big-picture explanation using animations or infographics to attract global learners, then briefly introduce key details.
- **Interactive engagement**: Incorporate polls, prompts, or questions in captions to appeal to active learners and encourage immediate interaction. For sequential learners, highlight "step-by-step hacks" in the video.
- **Fast-paced storytelling**: Use fast transitions, clear visuals, and text overlays to ensure comprehension in under 60 seconds while keeping the content engaging and structured.
- **Interactive and reflective elements**: Add interactive quizzes or "pause-and-think" moments to engage reflective and active learners. Include downloadable notes or infographics for deeper reflection.
- **Contextual relevance**: Begin with a relatable real-world scenario or case study to engage global learners and tie abstract concepts to practical applications. Use clear, linear visuals and summaries to cater to diverse learning styles.
- **Personalized call-to-action**: End videos with a specific, action-oriented challenge or task that viewers can try themselves, such as "Apply this tip in your next project!" or

"Comment your results below!" This caters to active learners who benefit from hands-on engagement and allows for interactive follow-ups.

- **Dual-mode explanations**: Combine verbal narration with synchronized text and visuals (e.g., split-screen animations or subtitles) to address auditory, visual, and sequential learners simultaneously. This layered approach ensures better comprehension for diverse learning styles while keeping the video dynamic and engaging.
- **Gamified elements**: Incorporate gamified components like "Can you solve this?" challenges or timed tasks within the video. This keeps viewers engaged, appeals to active learners, and adds an element of fun and interactivity.
- **Optimized length and pacing**: Keep videos between 30–60 seconds for TikTok and under 3 minutes for YouTube. Use a dynamic but moderate pacing that balances quick transitions for maintaining attention with pauses or highlights for key points, allowing both fast and reflective learners to process the content effectively.

4 Conclusion

The IGNITE study highlights diverse learning styles and preferences among students, with visual (47.2%) and hands-on (26.9%) methods being the most effective for engaging with new material. Auditory (12%) and reading/writing (13.9%) styles are less popular but still significant for some. Digital learning tools like videos are preferred when offering clear, sequential explanations (34.3%) and interactive quizzes (25.9%). Emotional connection is primarily fostered through hands-on experiences (38.9%) and visual aids (25%), while motivators include personal relevance (45.4%) and practical applicability (27.8%). These findings emphasize the need for personalized, visually engaging, and interactive content, particularly in nanomodules for sustainable innovation and entrepreneurship.

Cross-cultural differences also play a key role in learning preferences. Belgian students lean toward structured, academic approaches with a focus on visual, reading, and writing methods. French students prioritize hands-on and reflective learning, aligning with their interactive educational culture. Spanish students prefer dynamic formats like interactive quizzes and step-by-step explanations, engaging more in discussions and auditory learning while favouring a slower learning pace for reflection. Norwegian students excel with visual aids and hands-on projects, reflecting their progressive, student-centred education system. Slovenian students value practical and visual methods while avoiding reading-intensive approaches. These insights are crucial for creating culturally relevant and effective educational materials.

Visual learning dominates as the preferred cognitive learning style across countries, with nearly half of the participants favouring diagrams, charts, and other visual aids for understanding and retaining information. This highlights the importance of leveraging visually rich content to simplify complex concepts and enhance engagement. Similarly, sequential learning emerges as the dominant metacognitive learning style, with learners preferring a step-by-step approach to break down complicated topics into manageable parts. These preferences emphasize the need for educational materials that combine clear visual representations with structured, logical progression, ensuring content is both engaging and easy to follow for diverse learners. In addition, the cultural insights underscore the need for tailored educational materials that combine visual richness, structured progression, and interactive elements. By integrating these features into nanomodules for learning topics such as sustainable innovation and entrepreneurship, and adapting to regional preferences, educational content can become more effective and resonate with diverse learners across various digital platforms like Facebook, YouTube and TikTok.

Appendix 1: IGNITE emphatic questionnaire

Discovering learning styles: A questionnaire for developing nano-modules on sustainable and entrepreneurship innovation

COGNITIVE LEARNING STYLES

1. **How do you prefer to receive information?**
   a) visual
   b) auditory
   c) written
   d) hands-on
2. **When learning something new, what helps you most?**
   a) diagrams, charts, or visual explanations
   b) listening to an explanation or discussing the topic
   c) reading about the topic or writing notes
   d) trying it out for myself and learning by doing
3. **What motivates you to engage with content?**
   a) seeing how the content is relevant to my life or future goals
   b) hearing personal stories or testimonials about the content
   c) reading inspiring articles or case studies
   d) getting hands-on experience or trying it out myself
4. **When do you feel most emotionally connected to the content?**
   a) When I can visualize the information.
   b) When I can discuss it with others.
   c) When I can read about it deeply.
   d) When I can try it out practically.
5. **When learning about sustainable innovations, which method helps you understand the concepts best?**
   a) Seeing infographics, videos, or diagrams that illustrate sustainable innovations.
   b) Listening to podcasts, discussions, or presentations that explain the importance of sustainable innovations.
   c) Reading articles, research papers, or case studies that detail successful sustainable innovations.
   d) Engaging in hands-on projects or experiments that allow me to apply sustainable practices and innovations.
6. **Which method do you find most effective in exploring entrepreneurial innovation to tackle complex social challenges?**
   a) Using visual aids, such as infographics or concept maps, to understand innovative solutions and their frameworks.

b) Listening to expert panels or podcasts discussing real-world applications of entrepreneurial innovations for solving environmental challenges.
c) Reading case studies, research reports, or journal articles that provide insights into successful entrepreneurial strategies.
d) Participating in collaborative workshops or innovation labs where I can actively engage in problem-solving with peers.

METACOGNITIVE LEARNING STYLES

7. **When learning new material, which approach helps you understand and remember the information best?**
   a) I prefer engaging in group discussions or hands-on activities to immediately apply what I've learned.
   b) I prefer to take some time after learning to reflect on the material, helping me process and internalize the information.
   c) I prefer learning by breaking down complicated topics into smaller, simpler steps that I can follow one at a time.
   d) I prefer understanding how new concepts fit into a larger context.
8. **How fast do you prefer the content to be delivered when learning?**
   a) I like content to be delivered quickly, so I can jump right into discussions and apply what I've learned.
   b) I prefer a moderate speed, allowing me time to think and reflect on the material as I go along.
   c) I like a structured speed, where each concept is clearly explained before moving on to the next one.
   d) I enjoy a faster speed that gives an overview first, followed by details that connect to the bigger picture.
9. **How do you prefer to use digital technology and social media (like short videos) for your learning?**
   a) I prefer videos that include interactive quizzes or questions throughout, helping me stay engaged and apply what I'm learning in real-time.
   b) I prefer watching videos at a slower pace, allowing me to pause and take notes or reflect on key points before moving on.
   c) I like videos that break down concepts into clear, sequential steps, making it easy to follow along and to understand.
   d) I enjoy videos that give a quick overview first, then go into details, helping me see the bigger picture of the problem and connect new information to what I already know.