

VIRT²UE: DELIVERABLE 1.3 REPORT ON RESULTS FROM THE DELPHI CONSULTATION PROCESS

Project Details

Project full name	Virtue based ethics and Integrity of Research: Train-the-Trainer programme for Upholding principles and practices of the European Code of Conduct for Research Integrity
Project acronym:	VIRT ² UE
Start date of the project:	01.06.2018
Duration:	36 months
Project number:	787580

Deliverables details

Work Package	Work package 1 : Mapping of scientific virtues
Description of the deliverable	D1.3 Report on results from the Delphi consultation process
Work package leader	MEFST Sveuciliste u Splitu, Medicinski Fakultet
Responsible for the deliverable	Ana Marusic
Submission date	30-11-2019
List of contributors	Ana Marusic

	Vicko Tomic Ivan Buljan Ruzica Tokalic Rea Scepanovic
Reviewers	Kris Dierickx Daniel Pizzolato

Contents

1	About the VIRT ² UE project	5
1.1	Introduction	5
1.2	Aim of the project	6
1.3	About Work Package (WP) 1 – Mapping the scientific virtues	6
1.4	About deliverable D1.3.....	8
2	Methods	9
2.1	Design and description of a modified Delphi consensus method.....	9
2.2	Preparation	10
2.2.1	Face to face focus groups with stakeholders.....	11
2.2.2	Scoping review of virtues addressed in ethics and research integrity training	11
2.3	Participant recruitment.....	12
2.4	Data analysis	13
2.5	Ethical considerations	15
2.6	Data management and privacy	16
3	Report on three rounds of the Delphi consultation process	17
3.1	Round 1.....	17
3.1.1	Participants.....	17
3.1.2	Thematic findings	19
3.2	Round 2.....	29
3.2.1	Participants.....	29
3.2.2	Results	31
3.3	Round 3.....	37
3.3.1	Participants.....	37
3.3.2	Results	40

4	Conclusion	44
	Appendix 1. The questionnaire for the first round of the Delphi consensus process	46
	Appendix 2. The questionnaire for the first round of the Delphi consensus process	50
	Appendix 3. The questionnaire for the first round of the Delphi consensus process	55
	Appendix 4. Informed consent	61
	Appendix 5. Achieved consensus on statements about the meaning of virtues in research .	65
	Appendix 6. Achieved consensus on the importance of different virtues in ethics and research integrity training	66
	Appendix 7. Achieved consensus on statements about the overarching goals of virtue-based training for good research practice	68
	Appendix 8. Achieved consensus on the statements about the acquisition of virtues in research	69
	Appendix 9. Achieved consensus on the importance of different methods/techniques in ethics and research integrity training.....	70

1 About the VIRT²UE project

1.1 Introduction

Poor research practices can produce misleading results, waste resources¹ and decrease public trust in science,² therefore the scientific community needs to ensure the highest levels of ethics and integrity in the research that it produces. Research ethics is usually defined as the ‘critical study of the moral problems associated with or that arise in the course of pursuing research’ and research integrity as ‘possessing and steadfastly adhering to professional standards, as outlined by professional organizations, research institutions and, when relevant, the government and public’.³ In that sense, research ethics focuses on ethical aspects of the justification of research, while research integrity focuses on ethical aspects of doing research.

Most approaches to promoting integrity in research are principle-based in that they portray ethical conduct as consisting of adherence to ethical rules, duties, or responsibilities,⁴ but approaches focusing only on compliance and neglecting the development of a researcher’s intrinsic values do not provide adequate guidance for the real life research and situations not covered by rules and codes.^{5 6} In contrast to principle-based approach, the virtue-based approach focuses on the development of good character traits, which allows researchers to go beyond mere compliance by motivating them to strive for excellence in themselves and their practices.⁷ Compliance and development of good character traits are not however mutually exclusive. Virtue-based and principle-based approaches to ethics are complementary because they focus on different aspects of ethical conduct. Principle-based

¹ Ioannidis JP, Greenland S, Hlatky MA, Khoury MJ, Macleod MR, Moher D, et al. Increasing value and reducing waste in research design, conduct, and analysis. *Lancet*. 2014;383(9912):166-75.

² Mojon-Azzi SM, Mojon DS. Scientific misconduct: from salami slicing to data fabrication. *Ophthalmologica Journal international d’ophtalmologie International journal of ophthalmology Zeitschrift fur Augenheilkunde*. 2004;218(1):1-3.

³ Steneck NH. Fostering integrity in research: Definitions, current knowledge, and future directions. *Science and Engineering Ethics*. 2006;12(1):53-74.

⁴ Resnik DB. Ethical Virtues in Scientific Research. *Accountability in research*. 2012;19(6):329-43.

⁵ Pennock RT, O’Rourke M. Developing a Scientific Virtue-Based Approach to Science Ethics Training. *Science and Engineering Ethics*. 2017;23(1):243-62.

⁶ Steele LM, Mulhearn TJ, Medeiros KE, Watts LL, Connelly S, Mumford MD. How Do We Know What Works? A Review and Critique of Current Practices in Ethics Training Evaluation. *Account Res*. 2016;23(6):319-50.

⁷ Pennock RT, O’Rourke M. Developing a Scientific Virtue-Based Approach to Science Ethics Training. *Science and Engineering Ethics*. 2017;23(1):243-62.

approaches stress the importance of following moral rules, while the virtue-based approaches emphasize moral character development.⁸ In order to provide researchers with more adequate guidance, it is necessary to further develop the evidence base regarding which virtues should be stimulated and prioritised in training for good research practice.

1.2 Aim of the project

The VIRT²UE project aims to develop a sustainable train-the-trainer blended learning programme enabling contextualized ethics and research integrity (ERI) teaching across Europe focusing on understanding and upholding the principles and practices of the European Code of conduct for Research Integrity (ECoC).⁹ The training programme will be delivered using a blended learning approach: combining online and face-to-face teaching. This innovative blended learning programme will provide a toolbox of educational resources, based on an inventory of existing ERI educational resources, and incorporates an e-learning course with face-to-face sessions. VIRT²UE's online component will be delivered through the EC funded platform currently being developed in the EnTIRE project (http://cordis.europa.eu/project/rcn/210253_en.html).

The overall aim of the data collection within the project is to provide evidence and information for the development of a sustainable train-the-trainer blended learning programme and materials for ERI teaching across Europe.

1.3 About Work Package (WP) 1 – Mapping the scientific virtues

This work package is responsible for meeting the overall objective 1: Conduct a conceptual mapping amongst stakeholders about virtues that are crucial for good scientific practice and their relation to the principles of the ECoc. The ECoc formulates principles that are related to virtues, and these will be central to the development of VIRT²UE's training programme.

⁸ Resnik DB. Ethical Virtues in Scientific Research. *Accountability in research*. 2012;19(6):329-43.

⁹ ALLEA. The European Code of Conduct for Research Integrity Revised Edition, ALLEA - All European Academies, Berlin; 2017. Accessed: April 2019. Available at: https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf

There was a total of 5 main tasks and 17 subtasks in this work package:

T1.1 Scoping review of virtues addressed in ERI training.

1. Preparation of a search strategy for the scoping review.
2. Selection, analysis of publications and synthesis of the findings of the scoping review.

T1.2 Preparation for stakeholder consultation.

3. Identification of the representatives from different stakeholder groups for face-to-face focus groups from different domains.
4. Preparation of the protocol for the focus group meetings (questionnaire and scripts for the group meeting).

T1.3 Face to face focus groups with stakeholders.

5. Conduction of the first focus group.
6. Analysis of the results from the first focus group and adjustment of the scripts for the second focus group meeting in order to allow further in-depth discussion of the topics identified in the first focus group.
7. Conduction of the second focus group.
8. Analysis of the results from both focus groups and the generation of the initial list of virtues for training programmes.
9. Generation of the final list of virtues for discussion, with the input from the scoping systematic review.

T1.4 Modified Delphi consensus on virtues for the training programme.

10. Design of the questionnaire for the Delphi consensus process based on the literature results and results from focus groups.
11. Identification of 16 panellists for the Delphi consensus process (stakeholders from different domains, different from those participating in focus groups).
12. Conduction of the first round of the Delphi consensus process.
13. Conduction of the second round of the Delphi consensus process.
14. Conduction of the third round of the Delphi consensus process.

15. Presentation and discussion of the results of the Delphi process to the members of the consortium.
16. Drafting of the final list of virtues for the training programme.

T1.5 Assessing the acceptability and usability of the virtue ranking in the training programme.

17. Iteratively assessment the acceptability and usability of the virtue ranking during the development and assessment of the training programme.

1.4 About deliverable D1.3

The aim of this Deliverable was to involve a broad range of experts from different stakeholder groups and from different research domain in order to build a consensus on which virtues should be stimulated and prioritized in the virtue-based training for research integrity.

This Deliverable details the results of the first 18 months of the stakeholder consultation, including a description of the approach, the participants and the results from the three rounds of a Delphi consensus process. The results of the Delphi consensus process will also be taken into account in the adjustment of the VIRT²UE training programme because in this way they will be based on evidence from the state of the art in the field and from real-world consensus of stakeholders in the research process.

2 Methods

2.1 Design and description of a modified Delphi consensus method

We used a modified Delphi consensus method to achieve consensus among relevant experts about which virtues should have priority in ethics and research integrity training programme. The Delphi consensus process is an iterative survey method of research for consensus-building that uses a series of questionnaires or 'rounds' to gather information from a panel of selected experts. After each round, the experts are provided with controlled feedback consisted of an anonymised summary of their responses from the previous round and encouraged to revise their earlier answers. The process is repeated until certain degree of 'group' consensus on a specific topic is reached.^{10 11 12 13} This technique is useful for situations where individual judgements must be merged in order to address a lack of agreement because it allows the anonymous inclusion of a large number of individuals across diverse locations and expertise and avoids the situation where a specific expert might be anticipated to dominate the consensus process.^{14 15}

Over time, different authors have used the Delphi consensus process in a variety of studies so many variants of this method have been proposed. While these studies share some fundamental characteristics, such as feedback and iterative process, at the moment no universal guidelines on the use of the Delphi method exist and there is no standardization of methodology.^{16 17 18 19} Theoretically, the Delphi consensus process can be continuously

¹⁰ Goodman CM. The Delphi technique: a critique. *J Adv Nurs*. 1987;12(6):729-34.

¹¹ Hsu CC, Sandford, B. The Delphi Technique: Making Sense of Consensus. *Practical Assessment, Research & Evaluation*, 2007;12(10):1-8.

¹² Keeney S, Hasson F, McKenna H. Consulting the oracle: ten lessons from using the Delphi technique in nursing research. *J Adv Nurs*. 2006;53(2):205-12.

¹³ Powell C. The Delphi technique: myths and realities. *J Adv Nurs*. 2003;41(4):376-82.

¹⁴ Keeney S, Hasson F, McKenna H. Consulting the oracle: ten lessons from using the Delphi technique in nursing research. *J Adv Nurs*. 2006;53(2):205-12.

¹⁵ Powell C. The Delphi technique: myths and realities. *J Adv Nurs*. 2003;41(4):376-82.

¹⁶ Keeney S, Hasson F, McKenna H. Consulting the oracle: ten lessons from using the Delphi technique in nursing research. *J Adv Nurs*. 2006;53(2):205-12.

¹⁷ Pare G, Cameron A-F, Poba-Nzaou P, Templier M. A systematic assessment of rigor in information systems ranking-type Delphi studies. *Information & Management*. 2013;50:207-17.

¹⁸ Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *J Adv Nurs*. 2000;32(4):1008-15.

¹⁹ Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *J Adv Nurs*. 2000;32(4):1008-15.

iterated until a consensus is achieved but typically three rounds of questionnaires sent to a preselected expert panel are often sufficient to reach a consensus in most cases.^{20 21}

In order to achieve consensus about which virtues should be stimulated in ERI training programme, we conducted a Delphi consensus process of three rounds approximately one week apart. We planned that each round has a duration of two weeks but we extended the duration of the Round 1 and Round 2 to three weeks in order to achieve higher response rate. Data was collected from September to November 2019. The first round included an open-ended set of questions in order to allow and encourage participants to generate new ideas on scientific virtues with more freedom in their responses.^{22 23} The second round was developed based on the analysis of the results of round one with input from the results of previous studies conducted as part of the VIRT²UE project described in the next section. The participants rated the importance of all answers generated by all experts in previous rounds in order to develop group consensus. Similarly, in round three participants received the results of the analysis of round two's responses with statistical information presented to indicate items that have gained collective opinion. The protocol for this Delphi consensus process was pre-registered on OSF.²⁴

2.2 Preparation

In order to identify a preliminary topics and develop set of questions to present to experts in Round 1, we conducted other studies as part of the VIRT²UE project which includes scoping review of virtues addressed in ethics and research integrity training and face to face focus groups with stakeholders. Since the design of the questionnaires for the first two rounds of the Delphi consensus process was based on the results of these two studies, it is necessary to provide their summary descriptions.

²⁰ Hsu CC, Sandford, B. The Delphi Technique: Making Sense of Consensus. *Practical Assessment, Research & Evaluation*, 2007;12(10):1-8.

²¹ Powell C. The Delphi technique: myths and realities. *J Adv Nurs*. 2003;41(4):376-82.

²² Hsu CC, Sandford, B. The Delphi Technique: Making Sense of Consensus. *Practical Assessment, Research & Evaluation*, 2007;12(10):1-8.

²³ Powell C. The Delphi technique: myths and realities. *J Adv Nurs*. 2003;41(4):376-82.

²⁴ <https://osf.io/pmxaf>

2.2.1 Face to face focus groups with stakeholders

We conducted two mixed face-to-face focus groups discussions²⁵ with 21 participants which represented different stakeholder groups involved in research: academics, RI committees, policy makers, funding, students, industry and SME. Qualitative data generated during the focus groups discussions were analysed using a thematic approach. Four main themes were identified: virtues, context, acquisition of virtues and possible improvements. We concluded that participants have a different understanding of the word virtue, but they mostly see them as positive personal characteristics, traits of admirable quality or particular moral excellence. Participants discussed virtues under a different context, mostly religion and morality, society, science, and virtue antonyms. Understanding of virtues arises from that context. Since virtues are not inborn, they can only be acquired through learning.

Participants recognised socialization and education as a highly important process in which individuals acquire virtues. For the improvement of the acquisition of virtues participants suggested case studies and learning by example as a far more powerful tool than being lectured. Participants pointed out that continuous education through learning, training, mentoring and reflection is crucial for good research practice. The questionnaire for the first round of the Delphi consensus process was based on the results from focus groups (**Appendix 1**). Virtues identified during the focus groups discussions were also taken into account in the development of the questionnaire for the second round of the Delphi consensus process (**Appendix 2**).

2.2.2 Scoping review of virtues addressed in ethics and research integrity training

A comprehensive literature search was conducted to identify gaps in the virtue-based research training and to report which scientific virtues have been addressed in ethics and research integrity training. We used a scoping review study²⁶ because these studies are useful when a body of literature has not yet been comprehensively reviewed and when it has a large, complex, or heterogeneous nature. Publications considered relevant for inclusion were journal articles which evaluate ERI interventions, so we included

²⁵ Full text is available as a Deliverable D1.1 Report on the results from the stakeholder focus groups.

²⁶ Full text is available as a Deliverable D1.2 Scoping review of scientific virtues for training.

experimental, quasi-experimental, controlled before and after, before and after, interrupted time series studies and studies with post-test design. The results of the scoping review studies were taken into account in the development of the questionnaire for the second round of the Delphi consensus process (**Appendix 2**).

2.3 Participant recruitment

The participants were involved in the VIRT²UE project in order to provide evidence for the development of the training programme and materials. The stakeholder consultation consisted of face-to-face focus groups discussions and Delphi consensus process and it included participants from all major stakeholder groups involved in the research process. Stakeholders included in Delphi consensus process were different from those who participated in focus groups but the same procedures and criteria were used to identify and recruit research participants in both research.

The stakeholders' list was drawn first from institutional contacts and further recommendations from the experts from other WPs as well as public sources (e.g. internet). In this stakeholder consultation, the study does not seek to be fully representative, but rather to include a broad representation of people and disciplines. We tried to include all relevant stakeholders, primarily from the other EU grant meetings which gather a variety of stakeholders, and additionally sought representatives of stakeholder groups from the wider community.

The criteria for selecting specific stakeholder was based on the identified stakeholder categories: academics, research integrity committees, policy makers, funding and process organizations, students, industry and SME. We used a heterogeneous stratified purposive sample to reach a minimum of 16 participants. In addition to being a member of one of the identified stakeholder categories, criteria for inclusion in the stakeholder consultation was:

- Participants are currently active in some stage of the research process (e.g. research, education, policy, industry, research funding),
- Participants weren't involved in the VIRT²UE face-to-face focus group,
- Participants are over 18 years old,

- Participants are proficient in English.

A total of 74 invitations for participation in the Delphi consensus process have been sent to the experts. We used an online survey development cloud-based software SurveyMonkey to collect data from participants. Each potential research participant was contacted via e-mail and all participants who wanted to be a part of this study were asked to sign an Informed Consent Form by clicking on “I agree to participate”.

2.4 Data analysis

Data analysis involved the management of qualitative and quantitative data. Qualitative data was generated from the open-ended questionnaire in the first round of the Delphi consensus process. Analysis was performed using a qualitative data analysis computer software NVivo 12 Plus for Windows (QSR International).²⁷ Quantitative data was generated from the 101-point scale questionnaires in the second and third round of the Delphi consensus process. All quantitative data analysis was performed using a computer software IBM SPSS Statistics 26 for Windows (IBM Corp).²⁸

Round 1: In the first round, each expert received a questionnaire with basic demographic questions and open-ended questions based on the results from the focus group discussions. Qualitative data generated from the first round was analysed using thematic analysis. Thematic analysis is a method of identifying important or interesting patterns within qualitative data and using them to address a specific issue or research question. There are many different approaches to thematic analysis, but in this study we followed Braun & Clarke’s (2006) framework.²⁹ A deductive coding scheme was developed using preliminary data collection categories emerged from the results of the focus group discussions. When the deductive scheme insufficiently described a concept, further codes were developed from the open-ended questions. Codes were organized into potential themes by grouping similar items together, and were used for the development of the structured questionnaire for the second round.

²⁷ NVivo qualitative data analysis software; QSR International Pty Ltd., London, UK, Version 12; 2018.

²⁸ IBM SPSS Statistics for Windows, Version 26.0; IBM Corp., Armonk, NY; 2019.

²⁹ Braun V, Clarke V. Using thematic analysis in psychology, *Qualitative Research in Psychology*. 2008;3(2):77-101.

Round 2: In the second round, only the experts who participated in the first round received a structured questionnaire based on the information provided in the first round, results of the focus group discussions and the scoping review study. Quantitative data generated from the second round of the Delphi consensus process was analysed to obtain consensus on which topics are important for the ERI trainings and which scientific virtues should be included in them. We asked experts in an online survey sent via SurveyMonkey to rank the statements identified in the first round and previous studies. Statements were ranked with a 0-100 rating scale, ranging from the 'not important at all', to it is 'the most important'. The 0-100 broader scale was used based on the results of the focus group discussions since some of the participants emphasized that virtues represent an abstract idea that may be difficult to define and rate precisely, especially on a narrow rating scale, such as Likert. Experts were also encouraged to provide rationale or comments for their ratings. In the Delphi consensus process, decision rules and type of criteria to define and determine consensus must be established in order to assemble and organize the judgments and opinions provided by involved experts. In most studies, consensus is achieved if a certain percentage of experts' votes falls within a prescribed range, or through a median score based on a Likert-type scale.^{30 31} In our study, we looked into the percentage agreement of ratings from 61 to 100 for each statement. The consensus was defined a priori as greater than 70% agreement of ratings 61-100 among the experts, seeing as this level of agreement has been considered appropriate in previous Delphi studies.^{32 33 34 35} In order to keep Round 3 as short as possible, we excluded statements which have already obtained strong consensus in the second round. Those statements were excluded based on two criteria. based on two criteria. The first criteria was already mentioned consensus, defined a priori as

³⁰ Hsu CC, Sandford, B. The Delphi Technique: Making Sense of Consensus. *Practical Assessment, Research & Evaluation*, 2007;12(10):1-8.

³¹ Diamond IR, Grant RC, Feldman BM, Pencharz PB, Ling SC, Moore AM, et al. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol*. 2014;67:401–09.

³² Vogel C, Zwolinsky S, Griffiths C, Hobbs M, Henderson E, Wilkins E. A Delphi study to build consensus on the definition and use of big data in obesity research. *International Journal of Obesity*. 2019; <https://doi.org/10.1038/s41366-018-0313-9>

³³ van Hecke O, Kamerling PR, Attal N, Baron R, Bjornsdottir G, Bennett DL, et al. Neuropathic pain phenotyping by international consensus (NeuroPPIC) for genetic studies: a NeuPSIG systematic review, Delphi survey, and expert panel recommendations. *Pain*. 2015;156(11):2337-53.

³⁴ Downar J, Hawryluck L. What should we say when discussing "code status" and life support with a patient? A Delphi analysis. *J Palliat Med*. 2010;13(2):185-95.

³⁵ Slade SC, Dionne CE, Underwood M, Buchbinder R. Standardised method for reporting exercise programmes: protocol for a modified Delphi study. *BMJ Open*. 2014;4:e006682.

greater than 70% agreement among the experts on ratings 61-100 for each statement. For the second criteria, we have determined the level of agreement for each statement based on the median (0-19 – Strongly disagree, 20-39 – Disagree, 40-60 – Neither agree nor disagree, 61-80 – Agree, 81-100 – Strongly agree) since the major statistics used in Delphi studies are also measures of central tendency.^{36 37} According to those two criteria, we did not include statements to the questionnaire for the third round (**Appendix 3**) if they achieved strongly agreeing or strongly disagreeing based on median and consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100 for each statement.

Round 3: In the third round, only the experts who participated in the second round received a questionnaire with statements that did not obtain consensus in the second round. Also, they received anonymised summary of the first round responses, so that they could revise their earlier answers in light of the replies of all other members of the panel. As stated in the pre-registered protocol, the consensus for this round was defined only as agreement greater than 70% agreement on ratings 61-100 for each statement.

2.5 Ethical considerations

Within the Delphi, participants do not meet with each other face to face and therefore they can present and react to ideas unbiased by the identities and pressures of others.³⁸ Participants were not exposed to the risk of physical injury, financial, social or legal harm, and potential psychological risks will not exceed the daily life standard. Privacy and confidentiality of research participants and of the members of the community on the platform was protected. Before publishing information, confidentiality and privacy issues were addressed and informed consent was obtained (**Appendix 4**). We are not aware of and do not expect any potentially critical ethical implications of the research results such as the protection of dignity, autonomy, integrity and privacy of persons, biodiversity, protection of the environment, sustainability or animal welfare. Ethical standards and guidelines of Horizon2020 were rigorously applied. The Delphi consensus process was performed after

³⁶ Diamond IR, Grant RC, Feldman BM, Pencharz PB, Ling SC, Moore AM, et al. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol.* 2014;67:401–09.

³⁷ Keeney S, Hasson F, McKenna H. Consulting the oracle: ten lessons from using the Delphi technique in nursing research. *J Adv Nurs.* 2006;53(2):205-12.

³⁸ Goodman CM. The Delphi technique: a critique. *J Adv Nurs.* 1987;12(6):729-34.

having obtained the approval from the Ethics Committee of University of Split School of Medicine (Reg. No.: 2181-198-03-04-18-0044).

2.6 Data management and privacy

The data collected from the Delphi consultation process consisted of background characteristics of the participants and analysis of the results of three rounds of consultation on virtues for the training programme. The collected data will be made available in an open database format. The burden of responsibility for data protection lies with the University of Split School of Medicine (MEFST). All collected data will be stored for a period of five years after publication. In line with the open access movement, we will make the anonymised data publicly available on the Open Science Framework. If we notice that there is any data that even after anonymisation has the potential to be sensitive, we will send it to you to obtain consent for either deleting it, anonymising it further, or making it publicly accessible.

3 Report on three rounds of the Delphi consultation process

3.1 Round 1

3.1.1 Participants

A total of 31 experts completed a questionnaire for the first round of the Delphi consensus process (response rate 41.9%). The first round had participants of both genders: 54.8% women and 45.2% men. The median age of participants was 47 years (minimum 30, maximum 63; interquartile range 12). Fourteen European nationalities were represented and six participants were from outside of Europe. By involving experts from around the world, we have obtained some broader opinions on this global problem. **Table 1** shows the participants' country of residence. The categories of countries seen in the table were grouped according to the United Nations geoscheme system which divides the countries of the world into regional and subregional groups.^{39 40}

Table 1. Participants' country of residence

Country	n	%
Eastern Europe	1	3.2
Northern Europe	11	35.5
Southern Europe	5	16.1
Western Europe	8	25.8
Outside of Europe	6	19.4
<i>Total</i>	31	100.0

More than three-quarters of experts who participated in the first round had PhD/MD level of education. The self-reported highest level of education of the experts is presented in **Table 2.**

³⁹ UNSD. Methodology. Accessed: November 2019. Available at: <https://unstats.un.org/unsd/methodology/m49/>.

⁴⁰ Eastern Europe included Hungary; Northern Europe included Denmark, Norway, United Kingdom; Southern Europe included Bosnia and Herzegovina, Croatia and Spain; Western Europe included Austria, Belgium, France, Germany, Luxembourg, Netherlands and Switzerland; Outside of Europe included Australia, Bahrain, Brazil, Canada, Israel and Iran.

Table 2. Participants' highest level of education

Highest level of education	n	%
PhD/MD level	24	77.4
PhD student level	2	6.5
Masters degree level	4	12.9
Bachelor degree level	1	3.2
<i>Total</i>	31	100.0

Majority (>93.5%) of the experts in the first round considered themselves at least moderately experienced in RI issues. Almost half of the experts considered themselves experienced, followed by 41.9% of experts who considered themselves very experienced (**Table 3**).

Table 3. Participants' experience with research integrity issues

Experience with research integrity issues	n	%
Slightly experienced	2	6.5
Moderately experienced	2	6.5
Experienced	14	45.2
Very experienced	13	41.9
<i>Total</i>	31	100.0

The participants were currently active in a different type of the research process (**Table 4**), with academic researchers most strongly represented. The median years of participation in research and/or research-related activity of participants was 18 (minimum 4, maximum 35; interquartile range 12).

Table 4. Participants' involvement with type of the research process

Type of the research process	n	%
Academic researcher	20	64.5
Journal editor	11	35.5
Peer reviewer	17	54.8
Member of a research ethics or research integrity committee	8	25.8
Policy maker	2	6.5
Student	6	19.4
Working for a research funding or process organization	2	6.5
Other	4	12.9

The sum of the roles represented exceeds the number of participants because participants could select multiple roles.

The most common research discipline amongst the researchers who participated was biomedicine and social sciences. The self-reported disciplinary backgrounds of the researchers are presented in **Table 5**.

Table 5. Disciplinary background of researchers

Disciplinary background	n	%
Biomedical sciences	17	54.8
Social sciences	17	54.8
Natural sciences	6	19.4
Applied sciences	7	22.6
Humanities	12	38.7

The sum of the roles represented exceeds the number of participants because participants could select multiple disciplinary backgrounds.

3.1.2 Thematic findings

In order to design the questionnaire for the second round of the Delphi consensus process, we conducted a thematic analysis of the experts' opinions collected from the open-ended questions from the previous round. Five main themes were identified: 1. The meaning of virtues in research, 2. Virtues important in research, 3. Overarching goals of virtue-based training in research integrity, 4. Acquisition of virtues in research and 5. Possible improvements in training methods for virtues in research. Based on their responses, we created a list of statements under each theme. These statements were combined with results of the focus groups discussions and scoping review and provided in the questionnaire for the second round of the Delphi consensus process (**Appendix 2**).

3.1.2.1 *The meaning of virtues in research*

This theme deals with the meaning of virtues in research as described by experts in the first round of the Delphi consensus process. They most frequently understood virtues as personal qualities based on learned and reflected attitudes. In their opinion, a person can become a good researcher only through interaction with others. In that sense, virtues can be meaningfully shaped and developed over time.

Virtues mean an intrinsic behavior based on learned and reflected attitudes, which form our character and help us to make decisions in daily life.

P31, Western Europe

[...] professional and personal qualities of researchers while engaging in their research activities.

P3, Outside of Europe

[...] mutual learning between experienced and early Career researchers; Support each other in a process of continuous learning.

P15, Western Europe

In short, I think virtues are something you learn by personal experience (REAL cases) and that you have to feel emotionally before it can affect your moral. I think you need to experience the 'right feeling' more than once and need to be reassured that this behaviour was good, even though it may disadvantage you in the future... And I think that learning virtues is contextual and has to happen when a dilemma occurs, it is not something you can learn theoretically in an afternoon course, unfortunately...

P10, Western Europe

Some experts also emphasized that since virtues are character traits that contribute to human flourishing, research virtues could be understood as traits that enable researchers to make decisions that benefit the whole research process and all involved stakeholders.

Virtues are qualities of character that contribute to human flourishing, so it means practice research responsibly and with integrity.

P11, Eastern Europe

The qualities and characteristics the researcher brings to the research practice.

P26, Outside of Europe

Traits that can make us act in a way to pursue the best results aligned with an ethical attitude toward the whole research process.

P1, Outside of Europe

[...] points of character that are foundational to ethical decision-making.

P30, Western Europe

Others described virtues as an instrument for navigation in the research landscape which provides guidelines for proper behaviours in unknown situations.

A virtue is like a compass, providing guidelines for good practice in a messy research landscape.

P14, Northern Europe

Virtues mean "doing the right thing". This involves being aware of what is necessary to conduct and publish rigorous and ethical research (due diligence) and taking reasonable steps to meet those needs despite pressures to the contrary (time, money, effort, social disapproval, etc.).

P22, Northern Europe

[...] it is a general moral attitude which guides the behaviour of a person.

P10, Western Europe

Virtues were also recognised as universal for good research practice which means that they should be stimulated equally in every research sector or discipline.

My opinion is that virtues for good research practice are universal. There is no difference in basic virtues needed for responsible scientists for different research discipline. They are all based on the same principle in developing human knowledge and prosperity.

P7, Southern Europe

I think that virtues are universal, so that main virtues should be stimulated in every research sector or discipline.

P19, Southern Europe

3.1.2.2 Virtues important in research

This theme describes the most important virtues for good research practice. We asked experts to list up to five research virtues that are, in their opinion, the most important in research. They mentioned 45 different virtues in the first round of the Delphi consensus process and a complete list of these virtues is shown in **Table 6**. Honesty was recognised as the most important research virtue since it was mentioned the most frequently. Being collaborative and transparency were also frequently identified as important, as well as fairness, curiosity, integrity and perseverance.

Table 6. List of virtues mentioned during the first round of the Delphi consensus process in alphabetical order

<i>List of virtues</i>		
<i>Accountability</i>	Curiosity	Objectivity
<i>Accuracy</i>	Determination	Openmindedness
<i>Altruism</i>	Diligence	Openness
<i>Carefulness</i>	Empathy	Patience
<i>Clarity</i>	Enthusiasm	Perseverance
<i>Collaborative</i>	Fairness	Prudence
<i>Commitment</i>	Generosity	Reliability
<i>Communicativeness</i>	Honesty	Respect
<i>Compassion</i>	Humility	Responsibility
<i>Comprehensiveness</i>	Impartiality	Rigorousness
<i>Consistency</i>	Integrity	Temperance
<i>Courage</i>	Kindness	Thoroughness
<i>Courtesy</i>	Meticulousness	Transparency
<i>Creativity</i>	Modesty	Trust
<i>Critical</i>	Morality	Truthfulness

3.1.2.3 Overarching goals of virtue-based training in research integrity

In the first round of the Delphi consensus process, experts emphasized the identification of most important virtues as primary goal for virtue-based training for good research practice. Also, they pointed out that trainers should try to strengthen these virtues in researchers during training.

To address research virtues in formal research training.

P17, Outside of Europe

[...] to transmit to young researchers (and seniors) these core-virtues, in the aim to build a responsible research and to maintaining trust between science and society.

P16, Western Europe

Most importantly, trainers should motivate the researchers to implement the principles of good scientific practice and to develop positive attitudes and understanding of importance of these principles.

P8, Southern Europe

[...] development of virtuous traits in researches.

P8, Southern Europe

Gaining knowledge and understanding of ethical concepts were also recognised as one of the overarching goals of virtue-based training in research integrity.

[...] knowledge and deep understanding of ethical concepts and norms.

P8, Southern Europe

Train researchers in core ethical and integrity principles.

P26, Outside of Europe

To educate researchers as to what good research practice.

P12, Western Europe

Creating a broader understanding of virtues and ethics in research among stakeholders and in society at large.

P14, Northern Europe

According to our experts, trainers should try to raise awareness of the importance of virtues during virtue-based training in research integrity.

The overarching goal would be to raise awareness of the importance of virtues such as honesty, objectivity, persistence and openness to cooperate in conducting research.

P19, Southern Europe

[...] raise awareness about the human qualities required in research.

P3, Outside of Europe

Some experts suggested the provocation of self-reflection on the research practice as one of the overarching goals of these trainings.

To provoke a self reflection on the research practice and the compliance with the codes and guidelines.

P11, Eastern Europe

Establishing rooms and routines for reflection and deliberation on ethical issues and dilemmas.

P14, Northern Europe

The compliance with research codes and guidelines was identified as being potentially important in the virtue-based training in research integrity.

Deriving clear principles and explaining how they can be applied in day-to-day research.

P22, Northern Europe

To provoke a self reflection on the research practice and the compliance with the codes and guidelines.

P11, Eastern Europe

A better articulation of the broader set of principles related to the social responsibility of science.

P14, Northern Europe

The deliberation on ethical issues and dilemmas was also recognised as an important part of these trainings.

Open discussion on scientific virtues.

P1, Outside of Europe

Establishing rooms and routines for reflection and deliberation on ethical issues and dilemmas.

P14, Northern Europe

Participants of the virtue-based training in research integrity should learn what a researcher may gain from following good practice and the consequences of poor research practice.

A focus on how the trainee may gain from following good practice and the consequences for not following good practice may be most effective.

P22, Northern Europe

Making it clear why this is important in a way that will be meaningful to everyone - affects reputation positively (through rewards) or negatively (through sanctions/fines etc).

P23, Northern Europe

RE and RI trainers can demonstrate the severe consequences (to the quality of research output and potentially to societal trust in science) if such principles are not entertained. But training should be accompanied by regulatory and reward arrangements that are conducive to responsible conduct of research.

P4, Northern Europe

Experts also pointed out the improvement of problem-solving skills of trainees, as well as the critical analysis of questionable situations.

[...] possibility to critically analyze and discuss situations that include ethical questions to improve problem solving.

P8, Southern Europe

3.1.2.4 Acquisition of virtues in research

This theme deals with factors that have an influence on the process of acquisition of virtues in research. Experts emphasized that the process of acquisition of virtues in research could be improved if we address virtue-based ethics and research virtues in all ethics and research integrity trainings.

1. To address research virtues in formal research training. 2. To address research virtues in inspection of and reflection on the research culture.

P17, Outside of Europe

[...] it should be to not only communicate and disseminate practice-based RI/RE cases and codes of conduct, but training should also focus on the more character-based virtues that can be learned. for instance through examples of excellent research processes/role models etc.

P20, Northern Europe

Individual mentoring and mutual learning between experienced and early-career researchers were recognized as one of the most important parts of the acquisition of research virtues.

The researchers should mentor all young researchers to implement these principles, and in this way promote the principle of respect and accountability. Trainers should provide support to researchers for the mentoring process.

P8, Southern Europe

Individual mentoring of junior researchers.

P17, Outside of Europe

Experts also pointed out that research virtues can be acquired only through continuing education. In that sense, short and or once-in-a-lifetime virtue-based training cannot be effective.

I think courses, ESPECIALLY short courses, cannot change attitudes and values. If we stick to the technique though, I think having ambassadors, so a few people in each department, who do more training on integrity, and then become ambassadors, confidants, and motivators for departments? Like those who reward innovation and publications and media coverage in a department, but for good practices? I know it's a bit utopic... Otherwise, I can think that long-term courses with TRULY passionate professors can help... but they would have to come earlier, in the Bachelor's probably.

P10, Western Europe

Memorizing the facts was also identified as a non-effective way for the acquisition of research virtues because virtues are learned through experience and not through theory. Experts suggested real-life practice as the best approach for the process of the acquisition of research virtues. In other words, virtue-based training should be focused on real-life cases.

There is certainly no point in memorising these principles.

P13, Western Europe

We need to take a step back-- stop the memorizing and focus on rules and get inside people's hearts and minds -- what are they thinking and feeling -- map and understand this - create threads inside people where the juice running in their veins is moral goodness.

P30, Western Europe

Forget about seeing the Code as a set of RULES. Rules are boring and restrictive and people fight rules. People need a culture change in their heart and minds -- this is where the virtues come in. Memorizing rules is not the answer.

P30, Western Europe

[...] solving real-life cases through group analysis, brainstorming and creative ideas.

P29, Western Europe

Maybe 'bring your own REAL case' type of teaching.

P10, Western Europe

Some experts also emphasized that ethics and research integrity training should be mandatory for all stakeholders involved in the research.

Possible Future Improvements That Will Require Longer-Term Action: provide funding (secure and mid-long term) Improve Data Collection- cases and Entry make it mandatory for all PIs (+ Phd and Postdocs) (involve H2020 + EU funders + Universities).

P29, Western Europe

Within organisations, research integrity officers can mandate that all researchers complete training within 6-8 weeks of joining...

P23, Northern Europe

Others pointed out that virtue-based training should be adapted to each specific research disciplines because different research disciplines have different culture, organisation and regulations.

Different reseach sectors have different cultures and subjects. Different research sectors are organized and regulated in differentw ways (ethics vs law). Different modes of research have different societal aims (public vs private, economy vs democracy etc).

P14, Northern Europe

[...] in different disciplines there could be different aims. medical research should benefit patients, basic research should answer important questions.

P5, Outside of Europe

Teaching / training should reflect the actual problems and challenges to integrity that researchers encounter. These may vary across fields / sectors.

P4, Northern Europe

3.1.2.5 Possible improvements in training methods for virtues in research

This theme describes teaching methods and techniques that could have an influence on the improvement of the acquisition of virtues in research. We asked experts to list up to five teaching methods or techniques that are, in their opinion, the most important in ethics and

research integrity training. They mentioned 14 different teaching methods/techniques in the first round of the Delphi consensus process and a complete list of these virtues is shown in **Table 7**. Using case studies was recognised as the most important method since it was mentioned the most frequently. Discussions and lectures were also frequently identified as important, as well as role-playing, exemplar-centred approach, online courses, workshops and reflection.

Table 7. List of teaching methods/techniques mentioned during the first round of the Delphi consensus process in alphabetical order

<i>Teaching methods/techniques</i>		
<i>Bootcamps</i>	Individual mentoring	Reflection
<i>Case studies</i>	Interactive sessions	Role playing
<i>Dilemma issues</i>	Lectures	Video
<i>Discussions</i>	Online courses	Workshops
<i>Exemplar-centered approach</i>	Problem-based learning	

3.2 Round 2

3.2.1 Participants

A total of 23 experts completed a questionnaire for the second round of the Delphi consensus process (response rate 74.2%). The second round had participants of both genders: 43.5% women and 56.5% men. The median age of participants was 49 years (minimum 31, maximum 63; interquartile range 13). Eighteen European nationalities were represented and five participants were from outside of Europe. **Table 8** shows the participants' country of residence.

Table 8. Participants' country of residence

Country	n	%
Northern Europe	10	43.5
Southern Europe	3	13.0
Western Europe	5	21.7
Outside of Europe	5	21.7
<i>Total</i>	23	100.0

Almost nine-tenths of experts who participated in the second round had PhD/MD level of education. The self-reported highest level of education of the experts is presented in **Table 9**.

Table 9. Participants' highest level of education

Highest level of education	n	%
PhD/MD level	20	87.0
PhD student level	1	4.3
Masters degree level	2	8.7
<i>Total</i>	23	100.0

A large majority (>91.3%) of the experts in the second round considered themselves at least moderately experienced in RI issues. Almost half of the experts considered themselves experienced, followed by 39.1% of experts who considered themselves very experienced (**Table 10**).

Table 10. Participants' experience with research integrity issues

Experience with research integrity issues	n	%
Slightly experienced	2	8.7
Moderately experienced	2	8.7
Experienced	10	43.5
Very experienced	9	39.1
<i>Total</i>	23	100.0

The participants were currently active in a different type of the research process (**Table 11**), with academic researchers most strongly represented. The median years of participation in research and/or research-related activity of participants was 19 (minimum 5, maximum 35; interquartile range 13).

Table 11. Participants' involvement with type of the research process

Type of the research process	N	%
Academic researcher	17	73.9

Journal editor	10	43.5
Peer reviewer	14	60.9
Member of a research ethics or research integrity committee	7	30.4
Policy maker	2	8.7
Student	2	8.7
Working for a research funding or process organization	1	4.3
Other	4	17.4

The sum of the roles represented exceeds the number of participants because participants could select multiple roles.

The most common research discipline amongst the researchers who participated was biomedicine and social sciences. The self-reported disciplinary backgrounds of the researchers are presented in **Table 12**.

Table 12. Disciplinary background of researchers

Disciplinary background	n	%
Biomedical sciences	12	52.2
Social sciences	12	52.2
Natural sciences	3	13.0
Applied sciences	5	21.7
Humanities	9	39.1

The sum of the roles represented exceeds the number of participants because participants could select multiple disciplinary backgrounds.

3.2.2 Results

In Round 2, we presented 90 different statements grouped under five different topics which were established as themes during thematic analysis. Consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100 was reached on 54 statements. There were also 42 statements that achieved strongly agreeing or strongly disagreeing based on the median, but two of them did not meet criteria defined a priori as greater than 70% agreement among the experts on ratings 61-100, so they were included in Round 3.

Under the topic "Meaning of virtues in research", three statements were achieved consensus defined a priori as greater than 70% agreement among the experts on ratings 61-

100 with a strong level of agreement based on median and therefore they were excluded from the final round. Statement “Virtue is like a compass, providing guidelines for ‘doing the right thing’ in a messy research landscape, for example in unknown situations that are not covered by rules and codes” achieved highest agreement (87.0%) followed by statement “Virtues are character traits that contribute to human flourishing, so the research virtues are those traits that enable researchers to make decisions that benefit the whole research process and all involved stakeholders” which reached agreement of almost four-fifths of experts. The lowest level of agreement was on the statement “Virtues in research practice mean the same thing as virtues in general so there is no difference between research virtues and virtues in general” which reached an agreement of less than one-third of experts in the second round of Delphi consensus process. Complete list of these statements is shown in **Table 13.**

Table 13. Statements about the meaning of virtues in research

Statement	Ratings 61-100	% Agreement	Median	Interquartile Range
Virtues are based on learned and reflected attitudes, so a person can become a good researcher only through interaction with others. In that sense, we can meaningfully shape them and develop over time.	16/23	69.6	72	20
Virtues are difficult to define because they do not have clear boundaries; in general, they mean something good or positive.	11/23	47.8	60	46
Virtue is like a compass, providing guidelines for "doing the right thing" in a messy research landscape, for example in unknown situations that are not covered by rules and codes.	20/23	87.0	81	15
Virtues are character traits that contribute to human flourishing, so the research virtues are those traits that enable researchers to make decisions that benefit the whole research process and all involved stakeholders.	18/23	78.3	85	31
Virtues in research practice mean the same thing as virtues in general so there is no difference between research virtues and virtues in general.	7/23	30.4	37	49
Virtues for good research practice are	17/23	73.9	88	39

universal and they should be stimulated equally in every research sector or discipline.

Based on results from the focus group discussions, scoping review study and experts' responses from the first round of the Delphi consensus process, we created a list of 54 virtues that are relevant for research integrity. In the second round, experts provided their opinion on how important it is to include those virtues in ethics and research integrity training. Total of 29 virtues achieved consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100. There were also 23 virtues that achieved strongly agreeing or strongly disagreeing based on the median, but two of them did not meet criteria defined a priori as greater than 70% agreement among the experts on ratings 61-100, so they were included in Round 3.

Honesty and integrity achieved 100% agreement, followed by accountability, critical (being critical) and fairness which reached an agreement of more than nine-tenths (95.7%) of experts, as well as objectivity, open-mindedness, reliability, rigorousness, transparency and truthfulness (91.3%). The lowest level of agreement was on loyalty and temperance (39.1%), followed by altruism, compassion, empathy and positivity (47.8%). Complete list of these virtues is shown in **Table 14**.

Table 14. The importance of different virtues in ethics and research integrity training

Virtue	Ratings 61-100	% Agreement	Median	Interquartile Range
Honesty	23/23	100.0	100	2
Integrity	23/23	100.0	100	7
Accountability	22/23	95.7	95	15
Critical (being critical)	22/23	95.7	93	20
Fairness	22/23	95.7	95	16
Objectivity	21/23	91.3	90	30
Open-mindedness	21/23	91.3	90	29
Reliability	21/23	91.3	90	20
Rigorousness	21/23	91.3	91	24
Transparency	21/23	91.3	92	16
Truthfulness	21/23	91.3	100	10
Accuracy	20/23	87.0	90	18
Impartiality	20/23	87.0	90	30
Responsibility	20/23	87.0	93	14

Thoroughness	20/23	87.0	84	16
Clarity	19/23	82.6	81	30
Meticulousness	19/23	82.6	80	20
Morality	19/23	82.6	83	34
Openness	19/23	82.6	90	18
Reflexivity	19/23	82.6	80	25
Respect	19/23	82.6	82	30
Carefulness	18/23	78.3	80	35
Commitment	18/23	78.3	73	24
Curiosity	18/23	78.3	83	27
Diligence	18/23	78.3	83	32
Competency	17/23	73.9	80	30
Consistency	17/23	73.9	80	31
Perseverance	17/23	73.9	77	37
Skeptical (being skeptical)	17/23	73.9	77	29
Communicativeness	16/23	69.6	70	30
Courage	16/23	69.6	70	34
Generosity	16/23	69.6	72	37
Honourability (being honourable)	16/23	69.6	81	49
Humility	16/23	69.6	79	45
Prudence	16/23	69.6	75	31
Collaborative (being collaborative)	15/23	65.2	69	17
Trust	15/23	65.2	81	38
Creativity	14/23	60.9	70	33
Comprehensiveness	13/23	56.5	69	30
Courtesy	13/23	56.5	73	40
Patience	13/23	56.5	70	37
Compliance	12/23	52.2	63	30
Determination	12/23	52.2	63	29
Enthusiasm	12/23	52.2	66	31
Goodness	12/23	52.2	65	30
Kindness	12/23	52.2	64	51
Modesty	12/23	52.2	64	35
Unselfishness	12/23	52.2	65	40
Altruism	11/23	47.8	60	58
Compassion	11/23	47.8	60	41
Empathy	11/23	47.8	60	44
Positivity	11/23	47.8	60	30
Loyalty	9/23	39.1	52	34
Temperance	9/23	39.1	58	49

Eight statements on overarching goals of virtue-based training for good research practice achieved consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100. Six of those statements also achieved strong agreement based on the median, therefore, they were excluded from the final round. Complete list of these statements is shown in **Table 15**. Based on that results, we can conclude that goals of virtue-

based training for good research practice should include identification of the most important virtues and try to strengthen them in researchers, raising awareness of the importance of virtues, provocation of self-reflection on the research practice, deliberation on ethical issues and dilemmas, learning of learn what a researcher may gain from following good practice and the consequences for not following good practice and improvement of problem-solving, with critical analysis of questionable situations.

Table 15. The statements about the overarching goals of virtue-based training for good research practice

Statement	Ratings 61-100	% Agreement	Median	Interquartile Range
To identify the most important virtues and try to strengthen them in researchers.	21/23	91.3	99	19
To gain knowledge and understanding of ethical concepts.	18/23	78.3	77	35
To raise awareness of the importance of virtues.	20/23	87.0	81	29
To provoke self-reflection on the research practice.	21/23	91.3	95	20
To comply with research codes and guidelines.	20/23	87.0	80	18
To deliberate on ethical issues and dilemmas.	17/23	73.9	89	32
To learn what a researcher may gain from following good practice and the consequences for not following good practice.	17/23	73.9	85	40
To improve problem-solving, with critical analysis of questionable situations.	20/23	87.0	88	30
To focus primarily on the principles of the European Code of Conduct for Research Integrity.	9/23	39.1	51	40

Under the topic “Acquisition of virtues in research”, five statements were reached a strong level of agreement based on the median with consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100, therefore, they were excluded from the final round. The statement “Short and/or once-in-a-lifetime virtue-based training are not effective. Research virtues can be acquired only through continuing education” achieved highest agreement (95.7%) followed by statement “Virtue-based training should be focused

on real-life cases” which reached an agreement of almost nine-tenths of experts. The lowest level of agreement was on the statement “Individual mentoring and/or mutual learning between experienced and early-career researchers is the most important part of the acquisition of research virtues” which reached an agreement of less than two-thirds of experts in the second round of Delphi consensus process. Complete list of these statements is shown in **Table 16**.

Table 16. The statements about the acquisition of virtues in research

Statement	Ratings 61-100	% Agreement	Median	Interquartile Range
Virtue-based ethics and research virtues should be addressed in all ethics and research integrity trainings.	17/23	73.9	88	49
Individual mentoring and/or mutual learning between experienced and early-career researchers is the most important part of the acquisition of research virtues.	14/23	60.9	72	30
Short and/or once-in-a-lifetime virtue-based training are not effective. Research virtues can be acquired only through continuing education.	22/23	95.7	81	28
We acquire virtues through experience and not through theory; so the best approach should be based on real-life practice and not on memorizing the facts.	18/23	78.3	80	20
Virtue-based training should be focused on real-life cases.	20/23	87.0	84	29
Ethics and research integrity training should be mandatory for all stakeholders involved in research.	19/23	82.6	99	25
Different research sectors/disciplines have different culture, organisation and regulations so virtue-based training should be adapted to each specific research sectors/disciplines (e.g. different examples for different disciplines).	19/23	82.6	85	30

Based on experts’ responses from the first round of the Delphi consensus process, we created a list of 14 methods or techniques that are relevant for ethics and research integrity training. In the second round, experts provided their opinion on how important it is to

include those methods or techniques in ethics and research integrity training. Total of 8 methods or techniques achieved consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100. Five of those methods or techniques also achieved strong agreement based on the median, so they were excluded from Round 3. Case studies and discussions achieved the highest level of agreement (91.3%) followed by individual mentoring and workshops (87.0%). The lowest level of agreement was on boot camps and formal lectures which reached less than half of the experts' agreement (43.5%). Complete list of these virtues is shown in **Table 17**.

Table 17. The importance of different methods/techniques in ethics and research integrity training

Method/technique	Ratings 61-100	% Agreement	Median	Interquartile Range
Case studies	21/23	91.3	86	19
Discussions	21/23	91.3	81	20
Individual mentoring	20/23	87.0	85	25
Workshops	20/23	87.0	80	24
Dilemma approach	19/23	82.6	80	19
Exemplar-centred approach	19/23	82.6	73	10
Reflection	19/23	82.6	85	17
Problem-based learning	18/23	78.3	85	29
Round tables	16/23	69.6	70	29
Videos	14/23	60.9	67	29
Role playing	13/23	56.5	70	31
Online courses	11/23	47.8	60	32
Boot camps	10/23	43.5	50	26
Formal lectures	10/23	43.5	50	35

3.3 Round 3

3.3.1 Participants

A total of 22 experts completed a questionnaire for the third round of the Delphi consensus process (response rate 95.7%). The third round had participants of both genders: 45.5% women and 54.5% men. The median age of participants was 49 years (minimum 31, maximum 63; interquartile range 14). Seventeen European nationalities were represented and five participants were from outside of Europe. **Table 18** shows the participants' country of residence.

Table 18. Participants' country of residence

Country	n	%
Northern Europe	10	45.5
Southern Europe	2	9.1
Western Europe	5	22.7
Outside of Europe	5	22.7
<i>Total</i>	22	100.0

Almost nine-tenths of experts who participated in the second round had PhD/MD level of education. The self-reported highest level of education of the experts is presented in **Table 19**.

Table 19. Participants' highest level of education

Highest level of education	n	%
PhD/MD level	19	86.4
PhD student level	1	4.5
Masters degree level	2	9.1
<i>Total</i>	22	100.0

A large majority (>95.4%) of the experts in the second round considered themselves at least moderately experienced in RI issues. Almost half of the experts considered themselves experienced, followed by 40.9% of experts who considered themselves very experienced (**Table 20**).

Table 20. Participants' experience with research integrity issues

Experience with research integrity issues	n	%
Slightly experienced	1	4.5
Moderately experienced	2	9.1
Experienced	10	45.5
Very experienced	9	40.9
<i>Total</i>	22	100.0

The participants were currently active in a different type of the research process (**Table 21**), with academic researchers most strongly represented. The median years of participation in research and/or research-related activity of participants was 19.5 (minimum 5, maximum 35; interquartile range 14).

Table 21. Participants' involvement with type of the research process

Type of the research process	n	%
Academic researcher	16	72.7
Journal editor	10	45.5
Peer reviewer	14	59.1
Member of a research ethics or research integrity committee	7	31.8
Policy maker	2	9.1
Student	2	9.1
Working for a research funding or process organization	1	4.5
Other	4	18.2

The sum of the roles represented exceeds the number of participants because participants could select multiple roles.

The most common research discipline amongst the researchers who participated was biomedicine and social sciences. The self-reported disciplinary backgrounds of the researchers are presented in **Table 22**.

Table 22. Disciplinary background of researchers

Disciplinary background	n	%
Biomedical sciences	12	54.4
Social sciences	12	54.4
Natural sciences	3	13.6
Applied sciences	4	18.2
Humanities	9	40.9

The sum of the roles represented exceeds the number of participants because participants could select multiple disciplinary backgrounds.

3.3.2 Results

In Round 3, we presented 50 different statements grouped under five different topics which were established as themes during thematic analysis. Consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100 was reached on 22 statements.

Under the topic “Meaning of virtues in research”, only one of three presented statements achieved consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100. The statement “Virtues are based on learned and reflected attitudes, so a person can become a good researcher only through interaction with others. In that sense, we can meaningfully shape them and develop over time” achieved 86.4% level of agreement. The lowest level of agreement was on the statement “Virtues in research practice mean the same thing as virtues in general so there is no difference between research virtues and virtues in general” which reached an agreement of less than one-fifth of experts in the final round of Delphi consensus process. Complete list of these statements is shown in **Table 23**.

Table 23. Statements about the meaning of virtues in research

Statement	Ratings 61-100	% Agreement	Median	Interquartile Range
Virtues are based on learned and reflected attitudes, so a person can become a good researcher only through interaction with others. In that sense, we can meaningfully shape them and develop over time.	19/22	86.4	80.0	16
Virtues are difficult to define because they do not have clear boundaries; in general, they mean something good or positive.	7/22	31.8	52.5	24
Virtues in research practice mean the same thing as virtues in general so there is no difference between research virtues and virtues in general.	4/22	18.2	31.5	34

Based on results from the previous round, a list of 33 virtues that are relevant for research integrity was presented to experts in order to provide their opinion on how important it is to include those virtues in ethics and research integrity training. Total of 29 virtues achieved

consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100.

Meticulousness achieved a highest possible level of agreement (100%) followed by carefulness, competency, perseverance, and being sceptical which reached an agreement of more than nine-tenths (95.5%) of experts, as well as reflexivity (90.9%). Similar to the previous round, the lowest level of agreement was on temperance (13.6%), followed by altruism, compassion, loyalty and positivity (27.3%). Complete list of these virtues is shown in **Table 24**.

Table 24. The importance of different virtues in ethics and research integrity training

Virtue	Ratings 61-100	% Agreement	Median	Interquartile Range
Meticulousness	22/22	100.0	86.0	16
Carefulness	21/22	95.5	85.0	10
Competency	21/22	95.5	85.5	14
Perseverance	21/22	95.5	79.5	15
Skeptical (being skeptical)	21/22	95.5	80.5	13
Reflexivity	20/22	90.9	83.5	18
Collaborative (being collaborative)	19/22	86.4	71.5	15
Commitment	18/22	81.8	75.5	19
Communicativeness	18/22	81.8	77.0	16
Consistency	18/22	81.8	77.5	20
Humility	18/22	81.8	80.0	21
Patience	18/22	81.8	71.5	18
Honourability (being honourable)	16/22	72.7	70.0	30
Trust	16/22	72.7	70.5	24
Determination	15/22	68.2	68.5	22
Creativity	14/22	63.6	70.0	29
Prudence	14/22	63.6	65.0	28
Courage	13/22	59.1	71.0	29
Modesty	13/22	59.1	64.5	22
Enthusiasm	12/22	54.5	62.5	22
Unselfishness	12/22	54.5	64.5	31
Generosity	11/22	50.0	62.0	19
Goodness	11/22	50.0	60.0	21
Courtesy	10/22	45.5	59.0	23
Compliance	9/22	40.9	57.5	24
Comprehensiveness	7/22	31.8	55.5	19
Empathy	7/22	31.8	52.0	21
Kindness	7/22	31.8	55.0	27
Altruism	6/22	27.3	50.0	25
Compassion	6/22	27.3	52.5	25

Loyalty	5/22	22.7	39.5	41
Positivity	5/22	22.7	52.0	11
Temperance	3/22	13.6	39.0	34

Two of three statements on overarching goals of virtue-based training for good research practice achieved consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100 in the final round. The goals “To gain knowledge and understanding of ethical concepts” and “To comply with research codes and guidelines” and achieved more than nine-tenths of the experts’ agreement (90.9%), unlike the goal “To focus primarily on the principles of the European Code of Conduct for Research Integrity” which reached less than one-tenth of the agreement (9.1%). Complete list of the statements about the overarching goals of virtue-based training for good research practice is shown in **Table 25**.

Table 25. The statements about the overarching goals of virtue-based training for good research practice

Statement	Ratings 61-100	% Agreement	Median	Interquartile Range
To gain knowledge and understanding of ethical concepts.	20/22	90.9	84.5	10
To comply with research codes and guidelines.	20/22	90.9	87.5	13
To focus primarily on the principles of the European Code of Conduct for Research Integrity.	2/22	9.1	31.0	28

Under the topic “Acquisition of virtues in research”, both statements achieved consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100. Statement “We acquire virtues through experience and not through theory; so the best approach should be based on real-life practice and not on memorizing the facts” achieved almost nine-tenths (86.4%) of experts’ agreement, followed by statement “Individual mentoring and/or mutual learning between experienced and early-career researchers is the most important part of the acquisition of research virtues” with more than three-quarters (77.3%) of agreement (**Table 26**).

Table 26. The statements about the acquisition of virtues in research

Statement	Ratings 61-100	% Agreement	Median	Interquartile Range
Individual mentoring and/or mutual learning between experienced and early-career researchers is the most important part of the acquisition of research virtues.	17/22	77.3	71.5	19
We acquire virtues through experience and not through theory; so the best approach should be based on real-life practice and not on memorizing the facts.	19/22	86.4	80.0	21

Based on results from the previous round, a list of 9 teaching methods or techniques was presented to experts in order to provide their opinion on how important it is to include those virtues in ethics and research integrity training. Three of them achieved consensus defined a priori as greater than 70% agreement among the experts on ratings 61-100. Workshops achieved the highest possible level of agreement (100%), followed by the dilemma approach and exemplar-centred approach (95.5%). Similar to the previous round, the lowest level of agreement was on boot camps (4.5%) and online courses (18.2%). Complete list of these teaching methods or techniques is shown in **Table 27**.

Table 27. The importance of different methods/techniques in ethics and research integrity training

Method/technique	Ratings 61-100	% Agreement	Median	Interquartile Range
Workshops	22/22	100.0	84.0	11
Dilemma approach	21/22	95.5	80.5	13
Exemplar-centred approach	21/22	95.5	81.0	13
Round tables	13/22	59.1	64.5	20
Role playing	7/22	31.8	55.0	17
Videos	7/22	31.8	50.0	30
Formal lectures	6/22	27.3	50.0	37
Online courses	4/22	18.2	50.0	29
Boot camps	1/22	4.5	45.0	17

4 Conclusion

This Delphi consensus process on scientific virtues was able to reach consensus among a panel of experts on the majority of statements included in this study. We presented 90 different statements grouped under 5 topics to the experts and obtained a consensus among them on 62 statements (68.8%). These results should be taken into consideration in the process of adjusting the VIRT²UE training programme.

Under the topic “Meaning of virtues in research”, the consensus was achieved on four of six statements (66.7%). More details on achieved consensus on these statements are available as **Appendix 5**. Experts agreed that virtues in research could be understood as a compass because they provide guidelines for ‘doing the right thing’ in unknown situations that are not covered by rules and codes. According to the experts, research virtues can also enable researchers to make decisions that benefit the whole research process and all involved stakeholders. We can also conclude that virtues are based on learned and reflected attitudes, which means that a person can meaningfully shape them and develop over time. Since virtues for good research practice are universal, they should be stimulated equally in every research sector or discipline.

Experts reached consensus on 35 of 54 presented virtues in research which are important in the ethics and research integrity training (**Appendix 6**). These virtues should be central to the development of VIRT²UE’s training programme. Also, goals of these virtue-based training for good research practice should include identification of the most important virtues, provocation of self-reflection on the research practice, raising awareness of the importance of virtues, compliance with research codes and guidelines, improvement of problem-solving and critical analysis of questionable situations, gaining knowledge and understanding of ethical concepts, deliberation on ethical issues and dilemmas and learning what a researcher may gain from following good practice and the consequences for not following good practice (**Appendix 7**).

Topic about the “Acquisition of virtues in research” was the only topic which achieved a 100% level of agreement among the experts (**Appendix 8**). We can conclude that short

and/or once-in-a-lifetime virtue-based training is not effective since research virtues can be acquired only through continuing education. Also, this training should be mandatory for all stakeholders involved in research but also focused on real-life cases and not on memorizing the facts. Experts agreed that research virtues should be addressed in all ethics and research integrity trainings and these trainings should be adapted to each specific research disciplines because different research disciplines have different culture, organisation and regulations. Also, trainings should include some sort of individual mentoring and/or mutual learning between experienced and early-career researchers since that is one of the most important parts of the acquisition of research virtues. Experts also reached consensus on 8 of 14 presented teaching methods or techniques in ethics and research integrity training (**Appendix 9**). These teaching methods or techniques should be used during the implementation of VIRT2UE's training programme.

Appendix 1. The questionnaire for the first round of the Delphi consensus process

Welcome to VIRT²UE Delphi study

Thank you for your participation in this Delphi exercise.

The VIRT²UE project aims to develop a sustainable train-the-trainer blended learning programme enabling contextualized ethics and research integrity teaching across Europe. It focuses on understanding and upholding the principles and practices of the European Code of conduct for Research Integrity (ECOC).

Most approaches to promoting integrity in research are principle-based in that they portray ethical conduct as consisting of adherence to ethical rules, duties, or responsibilities, but approaches focusing only on compliance and neglecting the development of a researcher's intrinsic values do not provide adequate guidance for the real life research and situations not covered by rules and codes. In contrast to principle-based approach, the virtue-based approach focuses on the development of good character traits, which allows researchers to go beyond mere compliance by motivating them to strive for excellence in themselves and their practices.

We need your help to identify which scientific virtues should be stimulated and prioritised in training for good research practice.

Click on 'I agree to participate' to start the survey. See what you are agreeing to here.⁴¹

Part One: Background Information

1. What is your country of residence?

⁴¹ http://neuron.mefst.hr/docs/katedre/istrazivanja_bz/VIRT2UE/Additional%20info_consent%20VIRT2UE.pdf

2. What is your gender?
Mark only one choice.
 - a) Female
 - b) Male
 - c) Prefer not to say

3. What is your age in years?

4. Highest level of education.
 - a) PhD/MD level
 - b) PhD student level
 - c) Master's Degree level
 - d) Bachelor degree level
 - e) Other (please describe):

5. In which type of the research process you are currently active (e.g. research, publishing, policy, research funding). Mark all that apply.
 - a) Academic researcher
 - b) Journal editor (any role, from editor in chief to manuscript editor)
 - c) Peer reviewer
 - d) Member of a research ethics or research integrity committee
 - e) Policy maker
 - f) Researcher in industry or in SME
 - g) Working for a research funding or process organization
 - h) Student
 - i) Other (please describe):

6. How many years have you been active in research and/or research-related activity (please write only a number)?

7. In which discipline(s) do you work?
Mark all that apply.
 - a) Biomedical sciences
 - b) Social sciences
 - c) Natural sciences
 - d) Applied sciences (e.g. engineering)
 - e) Humanities
 - f) Other (please, describe):

8. How experienced are you with research integrity issues? (1= not experienced at all, 5 = very experienced)

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

Part Two: Scientific virtues

1. In your opinion, what do virtues mean in research practice?

2. Virtues are usually described as character traits which are conducive to being a flourishing human being, but the research virtues are those traits that make for an exemplary researcher. Please list up to five research virtues that, in your opinion, are the most important for good research practice.

3. Please provide the rationale for listing these virtues.

Part Three: Acquisitions of virtues

4. In your opinion, what should be the overarching goals of virtue-based training for good research practice?

5. Should different virtues be stimulated for different research sector/discipline? Please provide the rationale for your opinion.

6. The European Code of Conduct for Research Integrity describes fundamental principles for good research practices. These principles are:

- **Reliability** in ensuring the quality of research, reflected in the design, the methodology, the analysis and the use of resources.
- **Honesty** in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair, full and unbiased way.
- **Respect** for colleagues, research participants, society, ecosystems, cultural heritage and the environment.
- **Accountability** for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts.

In your opinion, what can ethics and research integrity trainers do to encourage researchers to integrate the European Code of Conduct principles into their everyday practice?

Part Four: Possible improvements

7. What objectives and content should be improved in order to promote the acquisition of virtues in ethics and research integrity training?

8. Please list up to five teaching methods/techniques which, in your opinion, can improve process of acquisitions of virtues.

9. Please provide the rationale for listing these methods or techniques.

10. Do you have any additional comments about scientific virtues? Are there any additional topics or issues that should be discussed?

Appendix 2. The questionnaire for the first round of the Delphi consensus process

Welcome to the second round of the VIRT²UE Delphi survey

Thank you for participating in the first round of the Delphi survey. At this stage, we collected your opinions about:

1. The meaning of virtues in research,
2. Virtues important in research,
3. Overarching goals of virtue-based training in research integrity,
4. Acquisition of virtues in research,
5. Possible improvements in training methods for virtues in research.

At this round, we invite you to express your opinion about these issues.

1. Meaning of virtues in research

Based on your responses, we created a list of statements on virtues in research practice.

Please read them individually and state your agreement with the following statements on a scale from 0 to 100: 0 = strongly disagree, 100 = strongly agree.

- 1) Virtues are based on learned and reflected attitudes, so a person can become a good researcher only through interaction with others. In that sense, we can meaningfully shape them and develop over time.
- 2) Virtues are difficult to define because they do not have clear boundaries; in general, they mean something good or positive.
- 3) Virtue is like a compass, providing guidelines for "doing the right thing" in a messy research landscape, for example in unknown situations that are not covered by rules and codes.
- 4) Virtues are character traits that contribute to human flourishing, so the research virtues are those traits that enable researchers to make decisions that benefit the whole research process and all involved stakeholders.
- 5) Virtues in research practice mean the same thing as virtues in general so there is no difference between research virtues and virtues in general.
- 6) Virtues for good research practice are universal and they should be stimulated equally in every research sector or discipline.

2. Virtues important in research

Based on your responses, we created a list of virtues that are relevant for research integrity.

Please read them individually and indicate your opinion on how important it is to include that specific virtue in ethics and research integrity training.

Please rate the importance from 0 to 100: 0 = not important at all, 100 = the most important.

The virtues are sorted alphabetically, so do not give up until the end of the question!

- 1) Accountability
- 2) Accuracy
- 3) Altruism
- 4) Carefulness
- 5) Clarity
- 6) Collaborative (being collaborative)
- 7) Commitment
- 8) Communicativeness
- 9) Compassion
- 10) Competency
- 11) Compliance
- 12) Comprehensiveness
- 13) Consistency
- 14) Courage
- 15) Courtesy
- 16) Creativity
- 17) Critical (being critical)
- 18) Curiosity
- 19) Determination
- 20) Diligence
- 21) Empathy
- 22) Enthusiasm
- 23) Fairness
- 24) Generosity
- 25) Goodness
- 26) Honesty
- 27) Honourability (being honourable)
- 28) Humility
- 29) Impartiality
- 30) Integrity
- 31) Kindness
- 32) Loyalty
- 33) Meticulousness
- 34) Modesty
- 35) Morality

- 36) Objectivity
- 37) Open-mindedness
- 38) Openness
- 39) Patience
- 40) Perseverance
- 41) Positivity
- 42) Prudence
- 43) Reflexivity
- 44) Reliability
- 45) Respect
- 46) Responsibility
- 47) Rigorousness
- 48) Skeptical (being skeptical)
- 49) Temperance
- 50) Thoroughness
- 51) Transparency
- 52) Trust
- 53) Truthfulness
- 54) Unselfishness

3. Overarching goals of virtue-based training

Based on your responses, we created a list of statements on the overarching goals of virtue-based training for good research practice.

Please read them individually and state your agreement with the following goals of virtue-based training on a scale from 0 to 100: 0 = Strongly disagree, 100 = Strongly agree.
To identify the most important virtues and try to strengthen them in researchers.

- 1) To gain knowledge and understanding of ethical concepts.
- 2) To raise awareness of the importance of virtues.
- 3) To provoke a self-reflection on the research practice.
- 4) The compliance with research codes and guidelines.
- 5) The deliberation on ethical issues and dilemmas.
- 6) To learn what a researcher may gain from following good practice and the consequences for not following good practice.
- 7) To improve problem-solving, with critical analysis of questionable situations.
- 8) To focus mostly on the principles of the European Code of Conduct for Research Integrity.

4. Acquisitions of virtues

Based on your responses, we created a list of statements on the process of acquisitions of virtues.

Please read them individually and state your agreement with the following statements on a scale from 0 to 100: 0 = strongly disagree, 100 = strongly agree.

- 1) Virtue-based ethics and research virtues should be addressed in all ethics and research integrity trainings.
- 2) Individual mentoring and/or mutual learning between experienced and early-career researchers is the most important part of the acquisition of research virtues.
- 3) Short and/or once-in-a-lifetime virtue-based training are not effective. Research virtues can be acquired only through continuing education.
- 4) We acquire virtues through experience and not through theory; so the best approach should be based on real-life practice and not on memorizing the facts.
- 5) Virtue-based training should be focused on real-life cases.
- 6) Ethics and research integrity training should be mandatory for all stakeholders involved in research.
- 7) Different research sectors/disciplines have different culture, organisation and regulations so virtue-based training should be adapted to each specific research sectors/disciplines (e.g. different examples for different disciplines).

5. Possible improvements in training methods for virtues in research

Based on your responses, we created a list of teaching methods/techniques that can improve ethics and research integrity training.

Please read them individually and indicate your opinion on how important it is to include that specific method/technique in ethics and research integrity training.

Please rate the importance from 0 to 100: 0 = not important at all, 100 = the most important.

Again, the methods are listed alphabetically.

- 1) Boot camps
- 2) Case studies
- 3) Dilemma approach
- 4) Discussions

- 5) Exemplar-centred approach
- 6) Formal lectures
- 7) Individual mentoring
- 8) Online courses
- 9) Problem-based learning
- 10) Reflection
- 11) Role playing
- 12) Roundtables
- 13) Videos
- 14) Workshops

Appendix 3. The questionnaire for the first round of the Delphi consensus process

Welcome to the third round of the VIRT²UE Delphi survey

Thank you for participating in the second round of the Delphi survey and welcome to the final round of the VIRT²UE Delphi study. We collected and analysed your opinions from the previous round about 90 statements about virtue-based training in research integrity. The summary of your responses is available here.⁴²

At this final round, we invite you to consider your earlier answers in light of the replies of other members of the consultation panel. After each question, a brief note is provided summarizing the general opinion from the previous round.

This survey is now much shorter because we have excluded statements that already have a strong agreement or strong disagreement.

1. Meaning of virtues in research

Based on your responses, we updated a list of statements on virtues in research practice. The statements with a strong agreement or strong disagreement were excluded.

Please read them individually and state your agreement with the following statements on a scale from 0 = Strongly disagree to 100 = Strongly agree.

A brief note is provided with each question to let you know what the general opinion was in the previous round.

- 1) Virtues are based on learned and reflected attitudes, so a person can become a good researcher only through interaction with others. In that sense, we can meaningfully shape them and develop over time.
Note to respondent: In the last round of questions, 69.6% of respondents agreed with this.
- 2) Virtues are difficult to define because they do not have clear boundaries; in general, they mean something good or positive.
Note to respondent: In the last round of questions, 47.8% of respondents agreed with this.
- 3) Virtues in research practice mean the same thing as virtues in general so there is no difference between research virtues and virtues in general.

⁴² http://neuron.mefst.hr/docs/katedre/istrazivanja_bz/VIRT2UE/VIRT2UE_delphi2-results.pdf

Note to respondent: In the last round of questions, 30.4% of respondents agreed with this.

2. Virtues important in research

Based on your responses, we updated a list of virtues that are relevant for research integrity. The virtues with a strong agreement or strong disagreement were excluded.

Please read them individually and indicate your opinion on how important it is to include that specific virtue in ethics and research integrity training.

Please rate the importance from 0 = Not important at all to 100 = Most important.

A brief note is provided with each question to let you know what the general opinion was in the previous round.

The virtues are sorted alphabetically, so do not give up until the end of the question!

- 1) Altruism
Note to respondent: In the last round of questions, 47.8% of respondents agreed with this.
- 2) Carefulness
Note to respondent: In the last round of questions, 78.3% of respondents agreed with this.
- 3) Collaborative (being collaborative)
Note to respondent: In the last round of questions, 65.2% of respondents agreed with this.
- 4) Commitment
Note to respondent: In the last round of questions, 78.3% of respondents agreed with this.
- 5) Communicativeness
Note to respondent: In the last round of questions, 69.6% of respondents agreed with this.
- 6) Compassion
Note to respondent: In the last round of questions, 47.8% of respondents agreed with this.
- 7) Competency
Note to respondent: In the last round of questions, 73.9% of respondents agreed with this.
- 8) Compliance
Note to respondent: In the last round of questions, 52.2% of respondents agreed with this.
- 9) Comprehensiveness
Note to respondent: In the last round of questions, 56.5% of respondents agreed with this.

- 10) Consistency
Note to respondent: In the last round of questions, 73.9% of respondents agreed with this.
- 11) Courage
Note to respondent: In the last round of questions, 69.6% of respondents agreed with this.
- 12) Courtesy
Note to respondent: In the last round of questions, 56.5% of respondents agreed with this.
- 13) Creativity
Note to respondent: In the last round of questions, 60.9% of respondents agreed with this.
- 14) Determination
Note to respondent: In the last round of questions, 52.2% of respondents agreed with this.
- 15) Empathy
Note to respondent: In the last round of questions, 47.8% of respondents agreed with this.
- 16) Enthusiasm
Note to respondent: In the last round of questions, 52.2% of respondents agreed with this.
- 17) Generosity
Note to respondent: In the last round of questions, 69.6% of respondents agreed with this.
- 18) Goodness
Note to respondent: In the last round of questions, 52.2% of respondents agreed with this.
- 19) Honourability (being honourable)
Note to respondent: In the last round of questions, 69.6% of respondents agreed with this.
- 20) Humility
Note to respondent: In the last round of questions, 69.6% of respondents agreed with this.
- 21) Kindness
Note to respondent: In the last round of questions, 52.2% of respondents agreed with this.
- 22) Loyalty
Note to respondent: In the last round of questions, 39.1% of respondents agreed with this.
- 23) Meticulousness
Note to respondent: In the last round of questions, 82.6% of respondents agreed with this.
- 24) Modesty
Note to respondent: In the last round of questions, 52.2% of respondents agreed with this.

- 25) Patience
Note to respondent: In the last round of questions, 56.5% of respondents agreed with this.
- 26) Perseverance
Note to respondent: In the last round of questions, 73.9% of respondents agreed with this.
- 27) Positivity
Note to respondent: In the last round of questions, 47.8% of respondents agreed with this.
- 28) Prudence
Note to respondent: In the last round of questions, 69.6% of respondents agreed with this.
- 29) Reflexivity
Note to respondent: In the last round of questions, 82.6% of respondents agreed with this.
- 30) Skeptical (being skeptical)
Note to respondent: In the last round of questions, 73.9% of respondents agreed with this.
- 31) Temperance
Note to respondent: In the last round of questions, 39.1% of respondents agreed with this.
- 32) Trust
Note to respondent: In the last round of questions, 65.2% of respondents agreed with this.
- 33) Unselfishness
Note to respondent: In the last round of questions, 52.2% of respondents agreed with this.

3. Overarching goals of virtue-based training

Based on your responses, we updated a list of statements on the overarching goals of virtue-based training for good research practice. The statements with a strong agreement or strong disagreement were excluded.

Please read them individually and state your agreement with the following goals of virtue-based training on a scale from 0 = Strongly disagree to 100 = Strongly agree.

A brief note is provided with each question to let you know what the general opinion was in the previous round.

- 1) To gain knowledge and understanding of ethical concepts.
Note to respondent: In the last round of questions, 78.3% of respondents agreed with this.
- 2) To comply with research codes and guidelines.
Note to respondent: In the last round of questions, 87.0% of respondents agreed with this.

- 3) To focus primarily on the principles of the European Code of Conduct for Research Integrity.

Note to respondent: In the last round of questions, 39.1% of respondents agreed with this.

4. Acquisitions of virtues

Based on your responses, we updated a list of statements on the process of acquisitions of virtues. The statements with a strong agreement or strong disagreement were excluded.

Please read them individually and state your agreement with the following statements on a scale from 0 = Strongly disagree to 100 = Strongly agree.

A brief note is provided with each question to let you know what the general opinion was in the previous round.

- 1) Individual mentoring and/or mutual learning between experienced and early-career researchers is the most important part of the acquisition of research virtues.

Note to respondent: In the last round of questions, 60.9% of respondents agreed with this.

- 2) We acquire virtues through experience and not through theory; so the best approach should be based on real-life practice and not on memorizing the facts.

Note to respondent: In the last round of questions, 78.3% of respondents agreed with this.

5. Possible improvements in training methods for virtues in research

Based on your responses, we updated a list of teaching methods/techniques that can improve ethics and research integrity training. The methods/techniques with a strong agreement or strong disagreement were excluded.

Please read them individually and indicate your opinion on how important it is to include that specific method/technique in ethics and research integrity training.

Please rate the importance from 0 = Not important at all to 100 = Most important.

Again, the methods are listed alphabetically. A brief note is provided with each question to let you know what the general opinion was in the previous round.

- 1) Boot camps

Note to respondent: In the last round of questions, 43.5% of respondents agreed with this.

- 2) Dilemma approach

Note to respondent: In the last round of questions, 82.6% of respondents agreed with this.

- 3) Exemplar-centred approach
Note to respondent: In the last round of questions, 82.6% of respondents agreed with this.
- 4) Formal lectures
Note to respondent: In the last round of questions, 43.5% of respondents agreed with this.
- 5) Online courses
Note to respondent: In the last round of questions, 47.8% of respondents agreed with this.
- 6) Role playing
Note to respondent: In the last round of questions, 56.5% of respondents agreed with this.
- 7) Roundtables
Note to respondent: In the last round of questions, 69.6% of respondents agreed with this.
- 8) Videos
Note to respondent: In the last round of questions, 60.9% of respondents agreed with this.
- 9) Workshops
Note to respondent: In the last round of questions, 87.0% of respondents agreed with this.

Do you have any other comments? (this is not a mandatory question)

Appendix 4. Informed consent letter

Invitation to participate in Delphi consensus process for the stakeholder consultation 'Virtue based ethics and Integrity of Research: Train-the-Trainer program for Upholding the principles and practices of the European Code of Conduct for Research Integrity (VIRT2UE)'

Dear Sir/Madam,

We at the VIRT²UE project aim to develop a sustainable train-the-trainer blended learning programme enabling contextualized ethics and research integrity teaching across Europe focusing on understanding and upholding the principles and practices of the European Code of conduct for Research Integrity (ECoC). This European Commission funded project seeks to include all stakeholders in a participatory way. As such, we are conducting an in-depth stakeholder consultation amongst people involved in research. We aim to consult: academics, researchers, educators, ethics/integrity committees, policy makers, students, representatives from funding and process organizations, and representatives from industry and small and medium enterprises.

We would like to invite you to participate in this stakeholder consultation via participation in three-round Delphi consensus process.

By agreeing, you commit to participating in three rounds of Delphi consensus process approximately 45 days apart. They will be led by researchers from University of Split School of Medicine, in collaboration with KU Leuven. As this is a Europe-wide consultation, the language of the focus groups will be English. All rounds of Delphi consensus process will take place in **spring 2019**. This letter contains details about the project and the stakeholder consultation so you can make an informed decision whether you would like to participate in the Delphi consensus process or not.

1. Aim of the Delphi consensus process

The Delphi consensus process is an iterative participatory method designed to transform opinion of panel of experts into group consensus through a series of structured questionnaires in several rounds. After each round, the experts are provided with anonymised summary of their responses from the previous round and encouraged to revise their earlier answers in light of the replies of other members of their panel until some degree of consensus is reached. The

results of the Delphi consensus process will help us adjust the training programme because in this way they will be based on evidence from the state of the art in the field and from real-world consensus of stakeholders in the research process.

2. What is involved?

If you would like to participate, we will invite you to Delphi consensus process which will consist of three rounds. The first round of questioning is anticipated to take place in **May 2019**. You will be asked to give your opinions in online questionnaire. This questionnaire should take around 30 minutes to complete and you will also have the opportunity to suggest further questions to be put forward to the panel. You will be given 2 weeks to complete and submit your considered responses. The research team will collate and evaluate all responses and then produce a report which sets out all responses and results of the study. Three weeks after the submission deadline for the first questionnaire, you will be sent a link to a second online questionnaire. This questionnaire will contain questions that may not have achieved consensus during the first round of questioning but there may also be additional questions added to this second questionnaire. You will be asked to review your initial response and be given the opportunity to amend your initial response should you wish to, based upon the overall response reported from the entire panel. You will be given 2 weeks to complete and submit this questionnaire with your considered responses. Again, the research team will collate and evaluate all responses and then produce a report with responses from the previous round. Three weeks after the submission deadline for the second questionnaire, you will be sent a link to a third and final online questionnaire. This round provides a final opportunity for you to revise your judgments so you will be asked to revise your earlier answers in light of the overall response reported from the first and second round. Overall data will be presented and reported within a final research report and you will receive a copy of this report.

Before participating in the Delphi process, we will ask you to complete a short questionnaire (sent via email and taking about 15 minutes) about your background: gender, age, role, years of experience, published publications, nationality and country of residence. The questionnaire will also include a couple of open questions about what you know about scientific virtues and scientific practice and their relation to the principles of the ECoC. The questionnaire will be anonymous (i.e., the survey platform will be programmed not to collect IP data).

3. Benefits and risks of participating

The direct benefits of participating in the research are that participants can share experiences and contribute to the development of the train-to-trainer learning programme, thus being able to actively bring in and broaden their knowledge and experience; mostly, however, the benefits are indirect, they will be accrued by the research community as a whole which will have open

access to online teaching material from this innovative blended (i.e. combined online and off-line approaches) learning programme designed to foster scientific virtues. There are no known risks to participation beyond those encountered in everyday life. Since Delphi methods maintain anonymity of the participants, your responses will remain confidential and anonymous. Data from this research will be kept under lock and key and reported only as a collective combined total.

4. If you do not want to join or want to stop the group conversation

Participation is voluntary. If you do not want to participate, you do not have to do anything and you are not required to let us know. If you decide to participate, you must sign the attached informed consent form and return it via email prior to the first round of consensus process. If you have agreed to participate but change your mind, you can of course withdraw at any point (including during the Delphi consensus process), we would ask you kindly to inform us if this is the case.

5. Use of data and dissemination of research findings to participants

Personal data will be destroyed within 6 months of the end of the Delphi consensus process. The questionnaires will be kept for up to **10 years** after the end of the study (in accordance with EU and Dutch/Belgian/Croatian data protection laws). All data is anonymised for analysis. The findings from the stakeholder consultation will also be published and made publically available on the Project's page on the European Commission research information portal: http://cordis.europa.eu/project/rcn/210253_en.html

6. Financial aspects

There is no fee paid for participation.

7. Do you have any questions?

Please do not hesitate to contact the consultation project coordinator, **prof. dr. Ana Marusic** ana.marusic@mefst.hr, if you have any questions.

Informed consent and confidentiality agreement

Please read the statements below in connection with the research 'Virtue based ethics and Integrity of Research: Train-the-Trainer program for Upholding the principles and practices of the European Code of Conduct for Research Integrity (VIRT²UE): stakeholder consultation' and sign if you are in agreement with all of the statements.

- I have read the information sheet.
- I was given the opportunity to ask any questions and any questions I did have were sufficiently answered.
- I had enough time to decide if I would join.
- I know that participation is voluntary. I also know that I can decide at any time that I would like to withdraw my participation and quit the study. I do not have to give any explanations.
- I give permission for collecting and using my data in the way and for the purposes stated in the information letter.
- I want to participate in this research.
- **I agree to maintain the confidentiality of the information discussed by all participants and researchers during the Delphi consensus process.**

Name:

Signature:

—

Date: __ / __ /

Appendix 5. Achieved consensus on statements about the meaning of virtues in research

Table 28. Achieved consensus on statements about the meaning of virtues in research sorted by the highest level of agreement

Statement	Round 1		Round 2	
	Ratings 61-100	% Agreement	Ratings 61-100	% Agreement
Virtue is like a compass, providing guidelines for "doing the right thing" in a messy research landscape, for example in unknown situations that are not covered by rules and codes.	20/23	87.0	-	-
Virtues are character traits that contribute to human flourishing, so the research virtues are those traits that enable researchers to make decisions that benefit the whole research process and all involved stakeholders.	18/23	78.3	-	-
Virtues for good research practice are universal and they should be stimulated equally in every research sector or discipline.	17/23	73.9	-	-
Virtues are based on learned and reflected attitudes, so a person can become a good researcher only through interaction with others. In that sense, we can meaningfully shape them and develop over time.	16/23	69.6	19/22	86.4

Appendix 6. Achieved consensus on the importance of different virtues in ethics and research integrity training

Table 29. Achieved consensus on the importance of different virtues in ethics and research integrity training sorted by the highest level of agreement

Virtue	Round 1		Round 2	
	Ratings 61-100	% Agreement	Ratings 61-100	% Agreement
Honesty	23/23	100.0	-	-
Integrity	23/23	100.0	-	-
Accountability	22/23	95.7	-	-
Critical (being critical)	22/23	95.7	-	-
Fairness	22/23	95.7	-	-
Objectivity	21/23	91.3	-	-
Open-mindedness	21/23	91.3	-	-
Reliability	21/23	91.3	-	-
Rigorousness	21/23	91.3	-	-
Transparency	21/23	91.3	-	-
Truthfulness	21/23	91.3	-	-
Accuracy	20/23	87.0	-	-
Impartiality	20/23	87.0	-	-
Responsibility	20/23	87.0	-	-
Thoroughness	20/23	87.0	-	-
Clarity	19/23	82.6	-	-
Meticulousness	19/23	82.6	22/22	100.0
Morality	19/23	82.6	-	-
Openness	19/23	82.6	-	-
Reflexivity	19/23	82.6	20/22	90.9
Respect	19/23	82.6	-	-
Carefulness	18/23	78.3	21/22	95.5
Commitment	18/23	78.3	18/22	81.8
Curiosity	18/23	78.3	-	-
Diligence	18/23	78.3	-	-
Competency	17/23	73.9	21/22	95.5
Consistency	17/23	73.9	18/22	81.8
Perseverance	17/23	73.9	21/22	95.5
Skeptical (being skeptical)	17/23	73.9	21/22	95.5
Communicativeness	16/23	69.6	18/22	81.8
Honourability (being honourable)	16/23	69.6	16/22	72.7
Humility	16/23	69.6	18/22	81.8
Collaborative (being collaborative)	15/23	65.2	19/22	86.4
Trust	15/23	65.2	16/22	72.7
Patience	13/23	56.5	18/22	81.8

Appendix 7. Achieved consensus on statements about the overarching goals of virtue-based training for good research practice

Table 30. Achieved consensus on statements about the overarching goals of virtue-based training for good research practice sorted by the highest level of agreement

Statement	Round 1		Round 2	
	Ratings 61-100	% Agreement	Ratings 61-100	% Agreement
To identify the most important virtues and try to strengthen them in researchers.	21/23	91.3	-	-
To provoke self-reflection on the research practice.	21/23	91.3	-	-
To raise awareness of the importance of virtues.	20/23	87.0	-	-
To comply with research codes and guidelines.	20/23	87.0	20/22	90.9
To improve problem-solving, with critical analysis of questionable situations.	20/23	87.0	-	-
To gain knowledge and understanding of ethical concepts.	18/23	78.3	20/22	90.9
To deliberate on ethical issues and dilemmas.	17/23	73.9	-	-
To learn what a researcher may gain from following good practice and the consequences for not following good practice.	17/23	73.9	-	-

Appendix 8. Achieved consensus on the statements about the acquisition of virtues in research

Table 31. Achieved consensus on the statements about the acquisition of virtues in research sorted by the highest level of agreement

Statement	Round 1		Round 2	
	Ratings 61-100	% Agreement	Ratings 61-100	% Agreement
Short and/or once-in-a-lifetime virtue-based training are not effective. Research virtues can be acquired only through continuing education.	22/23	95.7	-	-
Virtue-based training should be focused on real-life cases.	20/23	87.0	-	-
Ethics and research integrity training should be mandatory for all stakeholders involved in research.	19/23	82.6	-	-
Different research sectors/disciplines have different culture, organisation and regulations so virtue-based training should be adapted to each specific research sectors/disciplines (e.g. different examples for different disciplines).	19/23	82.6	-	-
We acquire virtues through experience and not through theory; so the best approach should be based on real-life practice and not on memorizing the facts.	18/23	78.3	19/22	86.4
Virtue-based ethics and research virtues should be addressed in all ethics and research integrity trainings.	17/23	73.9	-	-
Individual mentoring and/or mutual learning between experienced and early-career researchers is the most important part of the acquisition of research virtues.	14/23	60.9	17/22	77.3

Appendix 9. Achieved consensus on the importance of different methods/techniques in ethics and research integrity training

Table 32. Achieved consensus on the importance of different methods/techniques in ethics and research integrity training sorted by the highest level of agreement

Method/technique	Round 1		Round 2	
	Ratings 61-100	% Agreement	Ratings 61-100	% Agreement
Case studies	21/23	91.3	-	-
Discussions	21/23	91.3	-	-
Individual mentoring	20/23	87.0	-	-
Workshops	20/23	87.0	22/22	100.0
Dilemma approach	19/23	82.6	21/22	95.5
Exemplar-centred approach	19/23	82.6	21/22	95.5
Reflection	19/23	82.6	-	-
Problem-based learning	18/23	78.3	-	-