INTEGRITY

D3.3 Process for developing a quality checklist to assess education for the Responsible Conduct of Research (RCR)

Deliverable Code	D3.3_20191025_V1.0
Distribution Level	Public
Responsible Partner	UU
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	Date: October 25, 2019
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	Date: October 25, 2019

Content

List of terms and abbreviations

RCR:	Responsible Conduct of Research
Educational practices for RCR:	Covers a broad spectrum of educational practices for improving RCR, ranging from formal education (e.g. courses), to informal education (e.g. mentoring and supervision), and to non-formal education (e.g. via science musea).

1.   Introduction

The Horizon 2020 Integrity project aims to empower[1] students and early career researchers through education for Responsible Conduct of Research (RCR). It does so in an evidence-based way, and by using a scaffolded approach. This means that education for RCR will be tailored 1) to learners' educational level and discipline, and 2) to the specific needs that student groups may have in view of their ability to responsibly navigate issues of research integrity – current and new (i.e. in a way that is 'future proof').[2] 'Education' is taken in a broad sense, covering formal education (e.g. courses), informal education (e.g. mentoring) as well as non-formal education (e.g. via science musea).

To support evidence-based and scaffolded education for RCR that empowers students to responsibly navigate issues of research integrity, the Integrity project will, among other things:

- Develop a *quality checklist* that will serve as a benchmark to assess the effectiveness of educational practices in RCR training;
- Explicate the overall *didactical concept of RCR education,* aligned to the checklist; and
- Develop a view on 'how to assess'-tool to determine the effectiveness of educational programs and tools (with a prototype as a result) (D3.4).[3]

Performing quality checks to assess the effectiveness of education for RCR is an integral part of this. Indeed, in order to perform quality checks one has to have at least 1) a provisional list of relevant

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[1] 'Empowerment' will be operationalised in Deliverable 3.4 of the Integrity-project, which is due end of December 2019. Generally, this will include competences of individual students/researchers to maintain or promote Responsible Conduct of Research, also taking into account contextual and institutional factors that may present a challenge for RCR.

[2] The notion of 'future proof' competences will be fleshed-out in Deliverable 4.1 of the Integrity-project, which is due at the end of June 2020 (M18).

[3] Source: Grant Agreement Number 824586 – INTEGRITY Final, p. 15-16. Please note that we have reformulated these aims slightly (focusing on education instead of training) to align them with the overall objectives of the project.

quality criteria, and 2) a provisional view on how to assess education for RCR. Such quality criteria and a view on how to assess, moreover, ideally flow from an overall didactical concept of RCR education. That will include, for instance a clear idea about the relevant target groups of education for RCR, specific learning aims, and ways of measuring whether specific learning aims for specific target groups have been met. This report (D3.3) briefly describes the *process* through which the abovementioned objectives (performing quality checks, developing a quality checklist, et cetera) will be reached. *Substantive* results of the quality checks will be included in D3.4.

2. Towards a quality checklist for RCR education

The main elements of the process for developing a quality checklist are:

- Developing quality criteria and performing quality checks by utilising the results of multiple tasks and work packages. This includes building on the empirical results from prior work packages and tasks (section 2.1), and preliminary results from later work packages (sections 2.3.1 and 2.4);

- A targeted literature review, to gather promising ingredients for the quality checklist. Specifically, we will take the Predictive Modeling Tool as developed by Mulhearn et al. (2017a) as a starting point, and examine what would be needed in addition in order to be able to attain the objectives of the Integrity project. We will draw from a dedicated literature database that has been composed for this purpose (section 2.2);

- Feedback rounds pertaining to draft versions of the quality checklist, both from partners in the Integrity consortium, and relevant actors not directly involved in the project. Results will be included in two products: a report containing a *draft* quality checklist (D3.4, due December 2019), and a scientific article containing the final quality checklist (to be submitted after finalising WP4-6). That will allow us to optimally benefit from the empirical work done in other tasks and work packages (sections 2.3 and 2.4).

2.1. Building on empirical results from prior work packages and tasks

As indicated above, *substantive* results of the quality checks will be included in D3.4. This will allow us to benefit from empirical work performed as part of other tasks and work packages. Textbox 1 first describes substantive tasks and work packages that precede the development of the quality checklist for assessing education for RCR. Directly following Textbox 1, we briefly indicate how we think these empirical results will benefit the development of quality criteria and the quality checklist, and specify which results we will be able to incorporate in developing the quality checklist.

Textbox 1: Substantive tasks and work packages preceding the development of a quality checklist

Several activities in the Integrity project include empirical research that we think will benefit the development of quality criteria and a quality checklist for the assessment of education for RCR.

Workpackage 2 focuses on developing and employing a survey tool (questionnaire) Europe-wide to make an inventory at different levels and research areas of needs and perspectives of students in 10 countries in Europe.[4] More specific aims of this workpackage are:

1. To identify, map and evaluate existing understanding of students and early career researchers regarding academic and research integrity and key concepts in relation to questionable research practice and research misconduct, including fabrication, falsification and plagiarism; and
2. To map and categorize the grey area issues relating to good scientific practice that students and early career researchers are most likely to face in their daily practice and the extent to which these vary across cultural and disciplinary backgrounds.

Task 3.1 involves a review of the literature on teaching research integrity (1990-2018) for three different groups (high school students, undergraduate students (ba) and early career researchers

[4] Grant Agreement Number 824586 – INTEGRITY Final, p. 12.

(RM students and PhD candidates). The literature will be categorized according to relevant criteria, including target groups, disciplines, aim and focus of the teaching tools, working method, and evaluations and assessment of effects.

Task 3.2 involves mapping current practices of education for RCR in 10 European countries, by involving professional teachers and curriculum coordinators. This overview will include the target groups of education in research integrity, whether this is mandatory or optional, what the content and focus of educational programs is, and what working methods are being used. It will also focus on possible instructions for teachers on how to teach research integrity. One of the results will be that we will, relating the findings to the European Code of Conduct, reveal current blind spots in teaching.

Source: Grant Agreement Number 824586 – Integrity, p. 12-13, 15-16.

Building on the (preliminary) results of the activities outlined in Textbox 1 has important benefits. Most importantly, it allows for examining whether, taking into account the systematic meta studies on offer, we can formulate more *specific* quality criteria for the assessment of education for RCR that account for and accommodate the empirical findings of WP2 and WP3. For instance, the work done in WP2 (mapping the needs and understanding of students and early career researchers) provides relevant material to examine whether we can go beyond general quality criteria commonly found in the literature such as 'tailor education for RCR to the needs and understanding of students and early careers researchers', or 'successful research integrity courses are driven by well-defined learning outcomes that are relevant for learners'.[5] In keeping with the project planning, we will include preliminary results from a pilot questionnaire in WP2, as well as preliminary results from qualitative interviews in WP2 in preparing the draft quality checklist in task 3.3.[6]

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[5] The examples given in section 2.1 are taken from the preliminary outcomes of the literature review in task 3.1 (specifically, they are based on the meta studies Antes et al. 2009; Medeiros et al. 2017; Mulhearn et al. 2017b; Torrence et al. 2017; Watts et al. 2017a; Watts et al. 2017b) and the preliminary outcomes of the survey in task 3.2.

[6] The pilot-study was done in Portugal, Lithuania and The Netherlands.

In the same vein, we will use preliminary results from other tasks in WP3 as input for developing quality criteria and the quality checklist. The work done in task 3.1 (review of the literature on teaching research integrity)   provides insights into which educational approaches could be effective in promoting specific learning aims for specific target groups. That will allow for examining whether, again taking into account the systematic meta studies on offer, it is possible to formulate quality criteria more specific than, for instance 'Successful research integrity courses are offered to distinct groups of learners'. Finally, the work in task 3.2 (mapping current practices of education for RCR in 10 European countries) provides insights into, among other things working methods that are used in education for RCR in Europe. That, in turn, will be useful for examining the possibility of formulating quality criteria more specific than, for instance 'Successful research integrity courses employ adequate approaches to achieve the goals of the course'.

By examining whether it is possible to formulate more specific quality criteria than those commonly found in the literature we aim to provide those responsible for assessing and/or improving education for RCR with as practical as possible guidance on how students and early career researchers can be empowered to responsibly navigate current and new issues of research integrity.

2.2. Targeted literature search to gather ingredients for a quality checklist

To optimally build on the literature review in task 3.1, a more targeted literature search was organised in task 3.3 (quality checklist). This has resulted in a **literature database** taloired to the aims of tasks 3.3 that will serve as an additional source of inspiration in developing quality criteria and the quality checklist.

The literature database was composed using the following general strategy.[7] First, we made our methodology for the targeted literature search explicit, and used drafts of the document to create a shared vision of how the literature search should be performed, of what should and should not be included, and why. Then, we formulated a clear, well-defined research question of appropriate scope, tailored to the aims of task 3.3. Subsequently, we defined inclusion and exclusion criteria and key search terms, keeping in mind the connection between task 3.1 (focused on effectiveness of education for RCR) and task 3.3 (focused on quality checks and a quality checklist for assessing education for RCR), while limiting the potential for double work. This included formulating a preliminary list of issues that 'quality' might refer to in reflections on education for RCR.[8] We then identified relevant databases, and gradually performed the literature search.

To make sure that all researchers involved had a sufficiently similar approach, several workshops were organised at Utrecht University to discuss preliminary findings from the literature search. This resulted in several small (and well-documented) refinements of the inclusion and exclusion criteria, of the set-up of the format for coding the literature. Literature matching the key search terms was subsequently divided into three categories, based on the abstract (if available). Category 1 was used to indicate that according to the researcher, an article met the inclusion criteria; category 3 to indicate that it did not meet the inclusion criteria and should be excluded; and category 2 to indicate that the researcher was undecided. The results were included in an Excel-file in which the researchers involved could also include notes, for instance on why s/he was undecided about whether or not to include an article. To promote a common approach, the results of the first categorisation were hidden from view, after which another member of the team also categorised the articles. Differences in categorisation between team members were checked by the principal investigator. In a final plenary discussion with all team members a final decion was made about whether or not to include an article. At that point the literature database was complete, and the coding could begin.

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[7] The strategy and search terms used, as well as the criteria used to code the literature and the analysis of the literature will be described in detail in D3.4.

[8] E.g. the quality of instructions for teachers, the quality of education(al practices) for RCR, quality as part of the effectiveness of education for RCR, and the quality of ways of assessing the effectiveness of education for RCR.

During the **coding** of the literature in task 3.3, we came across a publication that seems particularly promising from the perspective of wanting to develop a quality checklist that can serve as a benchmark for the assessment of the (expected) efficacy of education for RCR, as well as serve as a tool for improving education for RCR. The publication in question is the work by Mulhearn et al. (2017), who have developed and validated what they call a Predictive Modeling Tool (PMT). According to the authors the PMT can be used 1) to develop courses for the Responsible Conduct of Research, 2) to assess the relative efficacy of courses for RCR, and 3) to improve the expected efficacy of courses for RCR. Based on two meta studies (Watts et al. 2017a; Watts et al 2017b) the PMT is a tool that allows users to score a current or intended course on 77 variables, after which the tool provides users a) with information on how the course scores relative to the efficacy of the studies that were used to validate the tool, and b) with recommendations on how the prospective efficacy of the course can be improved.

2.2.1. Standing on the shoulders of giants

Based on discussions in two workshops[9] it was decided to take the Predictive Modeling Tool as a startingpoint for our reflections on what a quality checklist needs to look like that can serve as a benchmark for assessing the efficacy of education for RCR, given the specific aims of the Integrity project (see Introduction). An important reason for focusing on this particular tool is that, to the best of our knowledge, the meta reviews underlying the development of this tool are the most extensive and systematic to date.

Subsequently, we have identified specific areas that do not seem to be included or play an important part in the Predictive Modeling Tool but are particulalrly relevant for the purposes of the Integrity project.[10] First, whereas the Integrity project covers **formal, informal, and non-formal education**, the

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[9] Utrecht University (28 May 2019), University of Zurich (15-16 July 2019).

[10] So far, the PMT has not been critically discussed by others in the scientific literature. Some of our first reflections on the usability of the PMT for the purposes of the Integrity-project were checked by contacting the corresponding author (prof. Mumford, University of Oklahoma) with a limited number of open questions.

Predictive Modeling Tool is primarily focused on formal education. We will therefore also map the literature on the importance and potential effects of mentoring (e.g. Plemmons & Kalichman, 2018; Anderson et al., 2007; Faden et al. 2002) and on the potential effects of non-formal education on the extent to which learning aims of education for RCR are met.

Second, whereas the Integrity project aims to include the **whole range of general learning aims** knowledge, skills, attitudes and behaviour,[11] attitudes seem to play a relatively modest role in the Predictive Modeling Tool, as part of self-reflection (Mulhearn et al. 2017). We will therefore examine the literature on the efficacy of education for RCR in promoting attitudes congruent to RCR,[12] and reflect on whether attention for attitudes congruent to RCR can be broadened and be made more explicit (beyond self-reflection) in tools for assessing education for RCR.

Third, whereas the Integrity project aims to develop tools for a **broad range of disciplines**, the studies used to validate the Predictive Modeling Tool are from the biomedical sciences and engineering, mostly.[13] Therefore, we will examine whether there is additional literature on the efficacy of education for RCR involving other disciplines as well, on the assumption that needs and effective approaches concerning education for RCR may differ between scientific disciplines.

Finally, whereas the Integrity project aims to develop educational tools for a **broad range of participants of education for RCR** (including high school students, bachelor students and PhD candidates), the Predictive Modeling Tool does not seem to include, for instance substantive studies including high school students. We will therefore map the literature on the efficacy of education for RCR involving the different target groups mentioned above.

Besides broadening the scope of the analysis of efficacy of education for RCR, as indicated above, we will also map the most recent literature on the efficacy of education for RCR that could not have been

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[11] These broad learning objectives need further specification, which will be provided in D3.4.

[12] This includes studies covered by the meta studies resulting in the Predictive Modeling Tool.

[13] Of the 28 studies used to validate the Predictive Modeling Tool, 17 are from the biomedical sciences, 5 from the field of engineering, 3 from the social science; 3 studies involve mixed disciplined. (Mulhearn et al. 2017)

included in the meta studies leading up to, for instance the Predictive Modeling Tool. We will also put reflection on assessing education for RCR in the broader context of mounting evidence about the influence of factors external to education on RCR – including the institutional setting in which education for RCR takes place. (see e.g. Kennedy et al. 2018) Institutional settings may be more or less accomodating to RCR. In our view, such interactions should ideally be taken into account when reflecting on the extent to which specific educational tools and approaches for RCR are effective in promoting desired learning aims. Such a view brings into focus questions such as: to what extent are the institutional conditions in place for RCR education to be effective? Whilst we will not be able to determine which institutional conditions need to be in place for that to be the case, we do consider it important to take such dependencies into account in assessing education for RCR. That way, an assessment that specific learning aims of, for instance formal RCR education have not been met, do not necessarily translate solely into questions how a *course* can or should be improved. For part of the solution might lie in adjusting the *setting* in which that course is given.[14]

2.3. From a draft to a final version of the quality checklist

The results of the different steps described above will be input for two products. A *draft* version of the quality checklist, view on how to assess, and didactical concept of education for RCR will be delivered as a **report** (D3.4, due December 2019). Subsequently, we will write a **scientific article** on developing the quality checklist for the assessment and improvement of education for RCR. The article will be ready for submission after finalising WP4-6. This will allow for including the final results from WP2 and WP3, and at least the preliminary results from WP4-6 as well.

The article will 1) describe the aims of the Integrity project, 2) reflect on what would be needed in addition to the Preditive Modeling Tool in order to meet those aims, as well as offer additional critical reflection on the Predictive Modeling Tool, 3) present the results of the targeted literature review alluded to above, and 4) offer conceptual reflection on the quality of education for RCR. The article will

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[14] The Predictive Modeling Tool treats the 77 course variables included in the tool as more or less independent from the institutional setting. Personal communication with prof. Mumford, corresponding author for the meta studies underlying the Predictive Modeling Tool.

culminate in 5) a 'final' quality checklist for the assessment of education for RCR and a view on how to assess, and 6) a research agenda (assuming that probably not all 'blind spots' can be solved in the course of the Integrity-project).

Concerning the **relation between the report (D3.4) and the scientific article**, we aim to limit overlap as much as possibe. This will be done, for instance by including in the report the substantive results of the quality checks, whereas the article will focus more on our search for quality criteria and ways to build on the Predictive Modeling Tool. To increase the attractiveness and usability of the quality checklist for intended users we will generally present the information and analysis in a layered way as much as possible, and will explore ways to visualise the quality checklist in an effective way, for instance by including in the report an interactive pdf (also see the next section).

2.3.1. Developing a taxonomy to specify the quality checklist

As part of the report (D3.4), we will develop a **taxonomy** of relevant concepts and issues related to (the assessment of) education for RCR. The taxonomy will subsequently be used to specify quality criteria and the (draft and final) quality checklist.

The taxonomy has two parts, one focused on conceptual clarification, the other on practical elaboration. **Conceptual clarification** is in order concerning, for instance learning aims, efficacy and quality.

- **Learning aims and objectives**:[15] proper assessment of education for RCR is impossible without a clear view on what are the learning aims or objectives of that education. (Bergsmann et al. 2015; Antes & DuBois 2014) We will build on some of the systematic work on the objectives and goals of education for RCR, taking the basic distinction between knowledge, skills, attidues

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[15] It is instructive to distinguish between learning aims/goals/objectives, on the one hand, and learning outcomes, on the other hand. Having clear learning *aims/goals/objectives* is a precondition for assessing education for RCR (Antes & DuBois, 2014). Actual assessments of education for RCR, in turn, measure learning *outcomes* (c.f. *European qualifications framework*, https://www.cedefop.europa.eu/en/events-and-projects/projects/european-qualifications-framework-eqf). This distinction allows for statements about the extent to which learning outcomes of education for RCR are in line with the (original) learning aims/goals/objectives of that education.

and behaviours as a starting point. These general objectives will be specified in D3.4 in such a way that it lays the groundwork for developing tailormade competence profiles[16] for the target groups included in the Integrity project: high school students, bachelor's students and PhD candidates.[17]

- **Effectiveness/ efficacy**: what concepts of effectiveness/ efficacy are used in the literature on education for RCR, and what options does this provide to develop an evidence-based quality checklist for the assessment of education for RCR? Potential challenges include 1) the worry that often studies used in meta reviews employ different concepts of efficacy that are somehow lumped together in the meta reviews; and 2) that whereas factors that could influence the efficacy of education for RCR can also interact, such interactions are often not addressed in meta reviews (for methodological reasons);

- **Quality**: what are the possible relations between effectiveness/ efficacy and quality of education for RCR? Often, quality of education for RCR is interpreted in terms of how effective that course is in achieving the learning aims of that course.[18] We will take a slightly broader approach in which there might be a large degree of overlap between the quality and efficacy of education for RCR, but at the same time room for regarding specific education for RCR as of high quality if, for instance not all of the learning aims of that education are met. This might be supported from a systems perspective in which reflections of the efficacy and quality of education for RCR are put in the broader context of (e.g. institutional) factors that may influence the extent to which learning aims of education for RCR can be met. Also, high quality education for RCR may involve factors that cannot easily be measured, providing additional reason for caution in reducing quality of education for RCR to the extent to which learning aims of that education are met.

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[16] Developing competence profiles is part of task 4.1 of the Integrity project.

[17] In developing this competence profile we will combine forces with the adjacent Erasmus+ Integrity project.

[18] This holds for instance for the studies underlying the Predictive Modeling Tool. Personal communication with prof. Mumford.

The second part of the taxonomy, **practical elaboration**, entails specifying workable and relatable learning aims, concrete working methods, and practical assessment tools aligned (i) to different types of education (formal, informal, non-formal), (ii) to a broad range of disciplines, and (iii) to different study phases (high school, undergraduate (ba) and PhD candidates.

Based on existing studies on the efficacy of education for RCR, as well as the empirical investigations in workpackage 2 and 3 of the Integrity-project, we will make an inventory of which working forms are most likely to contribute to achieving which learning aims for which target groups (disciplines, study phases) in the education for RCR (formal, informal, as well as non-formal) We will take the general distinction between assessment *of* education (e.g. course evaluations), and assessment *in* education (e.g. written assignments for students) as a starting point, further specifying this in terms of *what* eaxctly is assessed, and *how* it is assessed.

In order to increase both the attractiveness and the usability for intended users, we will explore possibilities to **visualise the taxonomy and quality checklist**, for instance through an interactive pdf that can be included in the report (D3.4), and that can be used (and published) as a separate tool as well. That way users are presented with key conceptual questions related to education for RCR, that they can further explore by clicking on a specific item (*conceptual clarification*). Likewise, users will be presented with key practical issues related to how students can be empowered in an evidence-based and scaffolded way through education for RCR (*practical elucidation*).

2.4. Two senses of performing quality checks

In closing, we envision two distinct senses in which quality checks can be performed. First, by checking the robustness of candidate criteria for the quality checklist that can be used as a benchmark for the assessment of education for RCR. This pertains to the quality of assessment tools. Second, by applying the quality checklist to educational activities for RCR. This pertains to the quality of education for RCR.

Specifying the quality checklist as indicated in Section 2.2.1 entails performing quality checks in the first sense. Quality checks in the second sense will be performed in the course of co-creating educational programmes and tools as part of the project (Workpackages 4–6).

While the quality checklist has to be robust enough in order to perform quality checks on these educational programmes and tools, we expect that performing these quality checks will also provide

useful information for the quality checklist itself, including on how the quality checklist could be refined. Therefore, we will regard the quality checklist list that is due December 2019 (report D3.4) as a semi-final draft, thereby leaving room for small refinements based on using the quality checklist as part of the process of co-creating educational tools and programmes with relevant target groups. As indicated the final version of the quality checklist will be presented in a scientific article.

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