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Exploring Teachers’ Concerns About Bringing Responsible Research and Innovation to European Science Classrooms

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ABSTRACT
The European Union pushes science education to orient toward the concept of Responsible Research and Innovation (RRI; i.e., socially and ethically sensitive and inclusive processes of science and technology). Schools should further understanding on how science interacts with society and increase students’ engagement in science. This exploratory study analysed concerns of 67 active, forward-looking teachers from 10 European countries using a questionnaire based on the concerns-based adoption model (C-BAM) and open-ended questions regarding the adoption of RRI into teaching. In the context of an international professional development programme on RRI, a pre/post comparison was also carried out for 29 of the teachers. The results showed that the forerunner teachers were willing to find information and collaborate on RRI teaching and believed that RRI can engage students and be a worthwhile part of the curriculum. Yet the respondents voiced personal concerns about their ability to teach RRI, and only a few concerns were resolved during the professional development period. Teachers need extended support and networking to contextualise RRI into their science lessons. On the basis of the results, we discuss the possibilities of teaching RRI implicitly rather than explicitly in order to foster students’ own reasoning about RRI-related values. Our results also demonstrate that the customary questionnaire used with C-BAM gives a consistent picture of teachers’ concerns but does not differentiate teachers enough in order to formulate a statistically sound clustering of concern profiles. We argue that with proper adjustments the questionnaire can provide more diverse and informative profiling of teachers’ concerns.

The problem
The European Union (EU) supports a renewal of science education by taking Responsible Research and Innovation (RRI) as a major crosscutting issue of the Horizon 2020 programme. In general, this concept aims to foster and facilitate research and innovation in an inclusive, societally oriented way (Sutcliffe, 2011). In the Horizon 2020 calls related to science education, the EU requests the development of educational activities that promote a culture of responsibility and participative inquiry. Science education should plant the seed for deepened debate between citizens, scientists, governments, civil organisations, business, and industry prioritising social, ethical, and environmental issues.
Through a number of EU-funded initiatives, RRI is likely to have a substantial influence in teacher professional development and in science classrooms across Europe (van den Hoven & Jacob, 2013). However, because of the novelty of the concept, teachers’ perspectives on RRI have not been investigated yet. The adoption of RRI into teaching is a complicated matter, and earlier experiences clearly demonstrate that teachers play a make-or-break role in the success of teaching innovations and reforms (Anderson & Helms, 2001; van Driel, Beijaard, & Verloop, 2001). Therefore, the aim of our study was to explore the concerns teachers face when adopting RRI into teaching.

According to the diffusion of innovations theory, the success of an innovation depends on the number of forerunners, who are actively seeking and refining novel approaches for their purpose. The number of forerunners—in the case of adopting RRI into teaching—depends on three things (Rogers, 2003). It is difficult to spread RRI in schools if teachers do not understand and accept the importance of the core ideas behind RRI. The challenge is to present RRI as a relatable and a meaningful concept rather than an EU policy. That is, RRI must be contextualised to the teaching of specific fields of contemporary science. Another factor in ensuring success lies in overcoming any personal difficulties teachers face, for example, in relation to their competency, efficacy, or motivation. A possible solution to this centres on promoting peer work and letting teachers have an influence on how RRI is incorporated into science curriculum. It is also important for the successful adoption of RRI that teachers have a supportive network providing not only materials and resources but also contacts to other dedicated teachers and RRI professionals.

Previous research on educational innovations other than RRI has described the complex beliefs and attitudes of teachers experiencing the adoption process from different viewpoints (Bailey & Palsha, 1992; Hall, Wallace, & Dosset, 1973; Lumpe, Haney, & Czerniak, 2000). Attitudes are typically seen as value laden (Kane, Sandretto, & Heath, 2002), but affective, cognitive, personal, social, and behavioural aspects also play a role in the construction of attitudes (Eagly, 1992; van Aalderen-Smeets, Walma van der Molen, & Asma, 2011). Our study used the concerns-based adoption model (C-BAM), in which concerns are defined as either negative or positive attitudes, and the Stages of Concern (SoC) questionnaire, which measures the intensity of concerns related to a specific stage (Dass, 2001; Hall et al., 1973). The stages relate to teachers’ self-concerns, task concerns, and impact concerns. A typical hypothesis is that during a successful adoption process teachers move through stages hierarchically and finally focus mainly on constructive concerns related to refining the use of an innovation (Hall et al., 1973). Another viewpoint suggests that teachers may experience a wide range of concerns related to different stages in no particular order (Hollingshead, 2009). These concern profile types depend on the teacher’s individual traits and experiences related to the adoption process. We argue that C-BAM could find broader use by developing toward the latter viewpoint, although so far only a few studies have applied the model for such a goal (Bitan-Friedlander, Dreyfus, & Milgrom, 2004; Hollingshead, 2009). The study reported here elaborates C-BAM as a tool for understanding teachers’ concerns in an early phase of a curricular reform to help the planning of professional development programmes (PDPs) and educational approaches. In addition to this front-end evaluation, we used C-BAM in the classical way (i.e., by collecting some data from teachers after they attended a professional development course to evaluate the impact of that course).

The study analysed the concern profiles of 67 primary and secondary school teachers related to teaching RRI in schools. The sample included teachers from 10 European countries.
surveyed before a PDP within the EU-funded Including Responsible Research and innovation in cutting Edge Science and Inquiry-based Science education to improve Teacher’s Ability of Bridging Learning Environments (IRRESISTIBLE) project (Apotheker et al., 2016). For the purpose of analysing the effect of this programme, 29 teachers were also surveyed after their participation in the project. In addition, we used open-ended questions to gain a deeper insight and to increase the validity of the findings from the SoC questionnaire.

These investigations aimed at answering our primary and secondary research questions:

- Primary research question: What kinds of concern profiles do teachers have related to teaching RRI in schools?
- Secondary research question: How did participation in the teacher professional development project resolve teachers’ concerns about teaching RRI in schools?

**Background**

**Research approach**

In their examination of research on science teacher PDPs, Luft and Hewson (2014) pointed out that existing and potential research on the field takes place in interactions between two or more of the organising components presented in Figure 1. The majority of PDP research focuses only on the effect of PDPs on teachers, and few studies include policy as a research component (Luft & Hewson, 2014). The research presented here focuses primarily on the highlighted connection (see Figure 1) between teachers and RRI as a policy. Because the EU policy of RRI has yet to be contextualised for European science classrooms, an exploration on teachers’ initial concerns about it provides a necessary starting point for designing an educational approach. Yet in the secondary research question we also include preliminary findings on the effects of PDP on these concerns.

Therefore, the primary research approach in this article is similar to that of many exploratory studies on teachers’ perspectives on novel topics and teaching methods (e.g., the prospects of incorporating nanoscience into curricula; Bamberger & Krajcik, 2012;
Laherto, 2011). Such studies address a policy- or research-based pressure for renewing school science and lay the groundwork for future developments in curricular work, teacher professional development, and teaching materials. Given the emerging influence and the novelty of RRI as an educational objective, our exploratory study provides important groundwork and guidelines for such developments in Europe.

Because of the exploratory nature of the study we used purposeful sampling (Patton, 1990), that is, we selected information-rich cases to gain valuable, in-depth knowledge of the issues of interest. Our sample—the 67 teachers of various science subjects, all school levels, and 10 countries—consisted of forerunners in the development of European science education. Each IRRESISTIBLE partner chose independently the method for recruiting teachers for the project, and the process was thereby certainly affected by partners’ personal networks. For that reason the resulting sample in this study could be labelled a sample of convenience. However, what was common among all teachers was that they participated voluntarily in IRRESISTIBLE in order to develop RRI teaching from the ground up and that they were experienced teachers actively seeking novel curricular emphases and improving their teaching practices. Given the purpose of the study, this sample can be considered very apposite.

We discuss the implications of respondents’ views and this study for the future of RRI teaching in Europe and elsewhere. Furthermore, we discuss how to improve C-BAM in order to achieve a more diverse profiling of teachers’ concerns.

**IRRESISTIBLE**

This study was carried out in the context of the IRRESISTIBLE project (Apotheker et al., 2016), which aims to enhance teachers’, students’, and the public’s understanding of RRI. Teachers of IRRESISTIBLE are developing teaching modules in 10 countries: Finland, Germany, Greece, Israel, Italy, The Netherlands, Poland, Portugal, Romania, and Turkey.

In PDP research, collaboration and discourse with colleagues and other experts has been identified as an important requirement for teacher growth (Dori & Herscovitz, 2005). IRRESISTIBLE brings teachers, scientific experts, educational experts, and science exhibition experts together to work within communities of learners (CoLs). In CoLs, teachers acquaint themselves with RRI and identify ways to incorporate aspects of RRI into their teaching and learning environments both within schools and beyond. CoLs are responsible for the development and implementation of teaching modules on a variety of socially relevant and contemporary fields of science, such as climate change, oceanography, nanoscience, renewable energy, the food industry, and genomics. This acquisition of content knowledge is supported by scientific experts from universities. New content knowledge has also been identified as an integral part of a PDP (Capps, Crawford, & Constas, 2012).

In the modules, CoLs incorporate several pedagogical themes, such as Web 2.0 applications, formal and informal learning environments, and inquiry-based science education. The modules are created in collaboration with universities, which provide the scientific content, and science museums, where students may design a museum exhibit. Although the museum exhibits and visits are an integral part of the modules, the majority of the teaching and learning happens at schools in teachers’ regular classes. The main task for the teachers and the other CoL members is to incorporate certain socially relevant and sensitive aspects of science into the teaching modules. Teachers must internalise and
apply these aspects within a period of 3 to 6 months. These aspects are referred to as RRI, which is a central theme in the project.

**RRI**

The European Commission (2014) has identified the growing need to bridge the gap between the scientific community and the rest of society during the 21st century. The predecessor of the concept of RRI was the action plan Science in Society launched by the EU in 2001. Since 2010, the focus has shifted from promoting the role of science in society to ensuring that the process and products of science and engineering are well aligned with the values, needs, and expectations of society. The framework for RRI suggests that this requires a continuous and reciprocal exchange of views between all societal actors. Six key points, presented in Table 1, have been identified within RRI (Sutcliffe, 2011).

The EU concept of RRI may be viewed as an adaptation of many contemporary and important ethical and educational ideas arising from the intersections among research, industry, and the public. In addition, common ground exists between RRI and current trends and concepts in science education. RRI contains similar ideas to concepts like the nature of science (Akerson et al., 2008), socioscientific issues (Zeidler, Sadler, Simmons, & Howes, 2005), and research on motivation and interest toward learning science.

As the most explicit manifestation of RRI, the six key points have faced some critique. Ruggiu (2015) argued that RRI entails two viewpoints contradicting each other. One interpretation of RRI emphasises the socioempirical process in which societal actors become mutually responsive through a democratic process, whereas the other interpretation sees that RRI is based on normative values (key points) set by the EU. The key points do not meet the interests of all stakeholders (e.g., open access may not be in the immediate

<table>
<thead>
<tr>
<th>Key points of RRI according to the European Union</th>
<th>Implementation in IRRESISTIBLE</th>
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<tbody>
<tr>
<td>Engagement to choose together: Engagement of societal actors, such as researchers, industry, policymakers, and civil society, for the dissemination of innovations and research.</td>
<td>Within IRRESISTIBLE, researchers work with students, teachers, and science museum experts. School students are taught about the role of different societal actors. Local individuals are affected via science museum exhibits.</td>
</tr>
<tr>
<td>Equality to unlock the full potential: Realising the full potential of individuals regardless of their gender or background.</td>
<td>Within IRRESISTIBLE, equality is taken into account in teaching methods as well as in teaching content. Students receive a realistic and diverse impression of scientists.</td>
</tr>
<tr>
<td>Science education through creative learning: Children’s interest in science education is one of the best ways to entice them to participate in future research and innovation.</td>
<td>IRRESISTIBLE uses cutting-edge science content and teaching methods, such as inquiry-based learning, to promote interest in science.</td>
</tr>
<tr>
<td>Open access refers to sharing to advance: Open access to publicly funded research publications and data must be granted, especially for those societal members who may distribute this information intelligibly.</td>
<td>Students are taught, for example, about the role of scientific information in society.</td>
</tr>
<tr>
<td>Ethics as doing the right thing: Ethics in research and innovation should be based on the shared values of European society.</td>
<td>Teaching content includes ethical issues related to research, the effects of applications on health and the environment, and the social acceptability of science. For example, students are allowed to assume different roles in society.</td>
</tr>
<tr>
<td>Governance such that science is for and with society: Implementation of these key points should be conducted in a sensible way.</td>
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*Note. The righthand column gives examples of how each key point could be implemented in teaching. RRI = Responsible Research and Innovation.*
interest of industry or science publishers). In order to find common ground societal actors should come up with shared values rather than adopt normative RRI values as given.

Although the EU has promoted RRI in society with a broad scope, only a few projects (e.g., ENGAGE, PARRISE, and RRI Tools) currently seek to implement RRI in schools. These projects aim to provide teachers with the tools to implement RRI in teaching while teachers are mostly left to decide on the remainder. Because RRI teaching is still in its adolescence, understanding the concerns of teachers is key in the diffusion of RRI. RRI is currently, and is likely to be in the future, a major theme in EU funding research grants.

C-BAM

C-BAM was originally developed during the 1970s (Hall et al., 1973). This is roughly the same time period when Rogers created the infamous model of diffusion of innovations (Rogers, 2003). The former addresses the diffusion process from the point of view of an adopter and his or her concerns, whereas the latter looks at the diffusion process as a whole in a general way and does not focus on affective qualities. Yet a curriculum change can be a stressful situation for a teacher. Teachers must be able to access information on innovation, adopt or develop their work resources, and collaborate with their colleagues. Throughout this process teachers have concerns that need to be addressed (Hall et al., 1973).

C-BAM, originally developed by Hall et al. (1973), expanded by Hall, George, and Rutherford (1977), and later refined by Bailey and Palsha (1992) and Shoulders and Myers (2011), represents a model for categorising different kinds of concerns and their effect on the diffusion process. Concerns may relate to available resources, one’s personal competence, consequences for students, or support from colleagues. C-BAM studies published so far have typically applied a seven-stage model, but some have used a different number of categories. Categories are usually based on self-concerns, task concerns, and impact concerns. Self-concerns can relate, for example, to how consistent the teaching innovation is vis-à-vis the teacher’s own skills, knowledge, and personal goals. Task concerns may stem from the teacher’s work duties or the prevailing structures and resources of a school. Impact concerns, among other things, may relate to the teacher’s values, any consequences for the work environment, any consequences for students, or the possibilities for future refinement of the innovation.

The SoC questionnaire

The SoC questionnaire is the most common application of C-BAM. SoC normally divides concerns among seven stages: being aware of the innovation, having information and being capable of internalising the innovation, having concerns related to one’s personal skills, managing the innovation in practice, being concerned about consequences, being concerned about collaboration, and finally being concerned about improving practices (Bailey & Palsha, 1992; Hall et al., 1977; Shoulders & Myers, 2011).

The awareness stage (Stage 0) is relevant only if some individuals within the organisation remain completely unaware of the innovation. This stage is called the zero stage because it is by nature different from the rest of the stages. Awareness items on the questionnaire do not inquire about concerns related to awareness but about whether the
teacher is or is not aware of the innovation. The remainder of the stages can be divided into two groups as follows.

The information stage (Stage 1), personal stage (Stage 2), and management stage (Stage 3) relate mostly to self-concerns and task concerns. Teachers with information concerns feel that they do not know enough about the innovation or that sufficient information is not available. Teachers with personal concerns feel that the innovation does not suit them or that they are incompetent in using the innovation. Management concerns relate to having insufficient time or resources. These so-called low-level stages are considered less valuable for teaching innovation than the stages described next. Yet the presence of many of these low-level concerns may indicate many things. For example, the project may still be in an early phase, teachers may be interested in knowing more, or teachers may hold attitudes against the innovation. Most concerns in these stages are considered negative and may need resolving before moving to the next concern stages.

The consequence stage (Stage 4), collaboration stage (Stage 5), and refocusing stage (Stage 6) stand as high-level stages and should be beneficial for the development of an innovation. Teachers with consequence concerns feel that the innovation might prove harmful for their students or that their working environment does not support the innovation. Collaboration concerns relate to finding colleagues or other experts to work with, and refocusing concerns relate to possibilities of refining the innovation further. Stage 4 is especially important for teachers, as their work has consequences for school students. Moving to these stages should be possible only if self- and task concerns have been sufficiently resolved.

A typical C-BAM study shows a change in concerns from low-level self- and task concerns to higher level impact concerns (Liu, 2005; Overbaugh & Ruiling, 2008; Shoulders & Myers, 2011). With this change, teachers' low-level concerns are resolved, which allows them to focus on the higher level stages. The information and personal stages are usually lessened more than the management stage. The collaboration stage normally remains quite high during the developmental period, whereas the refocusing stage should increase significantly as low-level stages are resolved.

Concern profiles
An idealised view of the SoC questionnaire states that teachers go through the stages one by one, moving from the awareness stage to the information stage, then to the personal stage, and finally to the refocusing stage. Teachers therefore experience only concerns related to the specific stage in which they are currently situated. A crude idealisation of the implications of a particular concern stage was carried out previously for the original C-BAM model, in which Hall et al. (1973) identified behaviour models linked to concern stages: unaware (Stage 0), awareness (Stage 1), exploration (Stage 2), early trial (Stage 3), limited impact (Stage 4), maximum benefit (Stage 5), and renewal (Stage 6). Each behaviour model goes hand in hand with the corresponding concern stage. This presents a limited viewpoint, however, because in reality teachers experience a wide range of concerns belonging to different concern stages simultaneously.

A broader way of identifying the effect of all concern stages is to derive concern profiles. Hollingshead (2009) identified four types, which are shown in Figure 2. The Resistor has concerns in many stages, particularly the management and personal stages.
The Resistor thinks that too many practical problems stand in the way of the innovation. He or she may also have many concerns in the refocusing stage, which indicates a wish to refine the innovation before accepting it.

The Ideal Implementer and the Overachiever express very few concerns in the low-level stages yet have high interest in consequence and collaboration, which may help the diffusion process. The difference between these two types is that the Overachiever is also concerned about refocusing the innovation. The next profile, the Co-operator, aligns closely with the Ideal Implementer but is more concerned about information, personal aspects, and the consequences of the innovation. Having many Co-operators at the beginning of the adoption process is productive for an innovation, as these individuals seek information and possess a willingness to collaborate yet have relatively few personal and management concerns. One has to remember that the differences between the concern profile types are subtle, which makes identification in real-world settings quite difficult.

Bitan-Friedlander et al. (2004) identified alternative concern types, including the Opponent, the Worried, the Co-operator, the Improver, and the Docile Performer. The Docile Performer has few information, personal, management, and refocusing concerns but a greater number of consequence concerns and a moderate number of collaboration concerns. The types identified in previous studies overlap to some degree. For example, the Docile Performer has a similar concern profile to the Overachiever.

![Theoretical concern profile types formulated in a previous study. For example, the Overachiever has few concerns in the awareness (awar.), information (info.), personal (pers.), and management (manag.) stages and many concerns in the consequence (conseq.), collaboration (collab.), and refocusing (refoc.) stages. Modified from Hollingshead (2009).](image-url)
A general trend in the research literature on SoC profiles suggests that the awareness, management, and refocusing stages accompany relatively low concern intensities. This produces the typical M-shaped profile. The Co-operator is closest to the M shape, but the Improver and the Docile Performer also have features similar to this shape. The M shape is most likely not a real result but a feature of the questionnaire arising from the differences in individual items. It is also sometimes difficult to say what a particular intensity of a concern stage means. For example, a teacher might have few information concerns because he or she has already learned enough. Another possibility is that the teacher just is not interested in learning about the innovation. This difficulty arises partly because the original questionnaire does not take the different nature of the questionnaire items into account: Some items are more positive than others. We therefore argue that refinements to the questionnaire are needed.

**Methods and analysis**

We began this research by adjusting the SoC questionnaire developed by Hall et al. (1977) to suit the context of RRI teaching. The Appendix provides a detailed list of the items included in the adapted questionnaire. Some items of the original questionnaire were completely irrelevant for teachers (yet relevant for other innovation adopters); therefore, they were omitted and new items (11, 19, 30, 31, 33) were formulated. For example, an item in the original questionnaire, “I would like to know the effect of reorganisation on my professional status,” seems irrelevant for teachers adopting RRI teaching. Adopting an innovation is always context dependent, and the new items were formulated to be relevant for teachers adopting RRI teaching. For example, one of the new items, “30. I would like to know more about the educational aspects of RRI,” is far more relevant for teachers than most of the omitted items. The downside of this approach is that the validity of the questionnaire and comparability with results from earlier C-BAM studies might be questioned. However, irrelevant items in the original questionnaire would also propose a threat to validity. We discuss validity further in the concluding section.

Agreeing with most items indicates a concern in a particular stage, although three items are reversed and indicate a lack of concern in a particular stage. Because the respondents in this study were about to participate in a project to develop RRI teaching, they were already aware of the concept, although they did not necessarily know the elaborate meanings of it. Therefore, it was reasonable to discard the awareness stage, which is not an actual concern stage anyway, as discussed earlier. Thus, the adjusted questionnaire consisted of 30 items and used a 5-point Likert scale (measuring agreement) with an additional response option of “I cannot say.”

The online questionnaire was translated into each partner’s local language, with the exception of those instruments used in Italy and Poland, where the English-language version was used. The translations were made by educational experts working in the IRRESISTIBLE project, who were able to use correct translations and clarify difficult concepts directly with us. The translations were also discussed in project meetings. In 2014, 67 teachers took 15 to 20 min to complete the questionnaire during the first meeting of the CoL in the IRRESISTIBLE project. The respondents were roughly aware of the concept of RRI and were interested in working on it, as they had volunteered for the project, but they had not yet received any training in RRI or elaborated the educational
applications of RRI. This timing for taking the questionnaire was carefully chosen to address the research questions in an optimal way. A total of 29 teachers also took the posttest, most of them during one of their last CoL meetings, whereas others answered in their spare time.

We removed Finnish teacher students from the analysis because their responses differed greatly from those of the other respondents, who were all in-service teachers. Teacher students responded significantly more frequently with “I cannot say” than in-service teachers (25% vs. 4%, respectively). Possible explanations for this may lie in differences related to culture, age, or the specific setting. The teacher students were participating in a mandatory course, whereas the teachers participated in the project voluntarily.

Among respondents from The Netherlands, Germany, Greece, Israel, Italy, Poland, Portugal, Romania, and Turkey, our total sample included 51 women and 16 men. Five teachers taught in primary school (one also in lower secondary), 13 only in lower secondary school, 33 only in higher secondary school, and 15 in both lower and higher secondary schools. Teachers were quite experienced: 29 teachers had more than 20 years of teaching experience, 19 teachers had 10 to 20 years of teaching experience, and 10 teachers had 5 to 10 years of teaching experience. Finally, 35 teachers taught chemistry, 29 general subject science, 17 physics, 16 biology, four technology, three geography, and two computer science.

All in all the sample was quite diverse and small. Given the exploratory nature of the study, the nature of the sample, and our focus on the first research question, we considered this arrangement appropriate. As discussed already, the sampling was motivated by choosing information-rich respondents (Patton, 1990) to explore the potential of an emerging curricular innovation. Indeed, teachers participating voluntarily in such a project are actively seeking novel curricular emphases and improving their teaching practice. Our experienced respondents can therefore be considered forerunners, or early adopters, of RRI teaching. Such teachers are also likely to take the initiative in the later phases of the development of curricula, training, and materials, and therefore their views should be examined and taken into account in the first place.

Each item of the questionnaire corresponded to a concern stage, and each concern stage represented a sum of these items. We defined the intensity of the concern stage per teacher simply by summing up the values of the responses on respective items. Full agreement with an unreversed item would yield +2, whereas full disagreement with the same item would yield −2. Agreeing or disagreeing slightly would yield +1 or −1. A concern profile was defined for each individual teacher and compared with those of other teachers. Recurring profile types were identified and compared to profiles found in other studies (Bitan-Friedlander et al., 2004; Hollingshead, 2009). The classification of a teacher to a specific profile was based on a comparison of the values for concern stage intensities. For example, the Co-operator profile type carries the highest values for the information, consequence, and collaboration stages; the second highest values during the personal stage; and the lowest values during the management and the refocusing stages. Thus, absolute values may differ between teachers across the same concern type because individual responses may differ systematically.

In order to validate the concern stages, teachers answered two open-ended questions inquiring about reasons for participating and expectations for the project: “What are your
reasons for participating in the IRRESISTIBLE project?” and “What are your expectations for this project?” Open-ended question responses were analysed during a project meeting in Bologna in March 2015. Analysis was completed by each country’s science education experts (two to four persons per group), who scrutinised the responses from their own country and searched for themes that emerged from those data. They provided a short description (a few words) of each theme and then counted its occurrence in the responses of the teachers of their own country. Afterward, we combined these analyses and searched for more general and most occurring categories qualitatively to see whether teachers came up with similar themes that were found in the results of the SoC questionnaire.

For the pre/post comparison a paired-samples $t$ test was used, which is suited for comparing two related groups. Our pre/post sample was too small to compare other groups, such as by gender or country, so we only compared the pre- and postscores of the whole group. The information and collaboration stages did not pass the normality assumption, so results for these stages are not verified.

**Results**

Figure 3 shows the distribution of pretest concern stage intensities for the total sample. Medians are shown as horizontal lines, the boxes show the quartiles closest to the median, and the whiskers show the further quartiles. The numbered dots represent outliers. The box and the top whisker of the collaboration stage have merged because more than 25% of the respondents had a maximum intensity of 10 in this stage. The information stage also had a high intensity, whereas the personal and the management stages had low intensities. This distribution resembles the Co-operator profile type in Figure 2. This shape, which is discussed in what follows, is also sometimes called the $M$ shape and is seen in many C-BAM studies.

![Figure 3](image.png)  
**Figure 3.** Distribution of concern stage intensities of 67 teachers. Boxes and whiskers represent quartiles around medians. Outliers are also marked. Similar to other studies, the distribution resembles the Co-operator type, although a ceiling effect is noticeable, especially for the first and fifth stages.
Concern profiles

We defined SoC profiles for individual teachers by comparing the relative intensities of concern stages. For example, a Co-operator would have relatively high intensities in the information, personal, consequence, and collaboration stages and relatively low intensities in the management and refocusing stages. For other profiles the order of intensities would be different. This type of relative method cancels out some of the individual’s tendency to use either end of the Likert scale—in such cases it is difficult to say what follows from this tendency and what is a real result. The downside of this method is that each teacher has to be carefully evaluated, and in some cases it is difficult to decide between two competing profile types. However, by comparing the relative intensities in the data and in the theoretical concern types, we found out that the great majority of teachers (n = 45) clearly belonged to the Co-operator type. Any other concern type mentioned in the literature was rare: We found only five Overachievers and two Resistors (Bitan-Friedlander et al., 2004; Hollingshead, 2009). The remainder, 15 teachers, did not clearly belong to a previously defined profile type. Ten of these teachers had intense concerns in almost all of the stages, four teachers had lower than average or neutral concerns, and one teacher had extremely few concerns. We also tried multiple different clustering techniques (e.g., hierarchical and k-means cluster analysis), but this resulted in uneven clusters in which most teachers belonged to the same cluster. Teachers seemed to cluster relatively close to the average concern intensity scores (see Figure 3).

One of the reasons that the majority of the teachers were Co-operators was that most respondents whose information concerns were in the lowest quartile or below also had few concerns in other stages. Very few teachers had higher than average concerns in one stage and lower than average concerns in another stage at the same time. This was why so few Ideal Implementers or Overachievers appeared in the results.

There were, however, some interesting distinctions between teachers. The personal stage especially seemed to differentiate teachers quite well. Teachers well above the median were concerned about their personal role and competency in RRI teaching. Three teachers had very few personal concerns, whereas three teachers had very high personal concerns. Only 1/16 male teachers had higher than average personal concerns versus 15/51 females. Although the small subsample size did not allow for statistically valid comparisons, there may have been some variance in personal concern levels between countries. For example, 5/7 Italian teachers had high personal concerns as opposed to The Netherlands with only 1/8 and Portugal with 3/11.

In order to see whether some teachers belonged to a previously unidentified profile, we tried multiple different kinds of cluster analyses. They only confirmed that the results were too homogenous for profiling. A hierarchical cluster analysis with centroid clustering and squared Euclidian distance calculations revealed that more than 90% of the teachers belonged to the same cluster. A k-means clustering analysis also created a dominating single cluster.

Thus, it seems that most teachers in this study sought information about RRI teaching, were willing to collaborate, and were interested in the consequences of RRI teaching for students or for their work. According to Figure 3, teachers also expressed low concern intensities on average related to the personal and management stages. However, the personal stage seemed to divide teachers into those who were slightly concerned about their personal capabilities in terms of RRI teaching and those who were not. The teachers in this study appeared to be ready to move forward with RRI teaching but were not yet ready to further refine it.
Open-ended questions

The content analysis of the responses to the two open-ended questions, carried out by the science education researchers as described in "Methods and Analysis," produced on average seven themes per country. Each theme was described by a few words. In the next phase of the analysis, we compared these results, combined identical themes, and aggregated thematically similar themes under more general categories. In this process, we synthesised the categories independently, then negotiated and found consensus rather easily. We ended up with six main categories. The same six categories were found in both the question related to reasons for participating and the question related to project expectations, revealing that the questions were not very distinct in respondents’ minds.

In Table 2 we present the main categories, with some examples of themes for each category, from the analysis of responses to the first question. For example, better practice in class and growing as a teacher were considered to belong to a broader category “development of teaching.” In the following we illustrate the categories with some typical quotations from the respondents and discuss the findings in relation to quantitative results from the SoC questionnaire. One can argue that most categories related to teachers’ interests and concerns and may have encompassed more detail than the SoC questionnaire.

As shown in Table 2, “development of teaching” emerged as an important reason for participating in the project (e.g., “I want to learn new teaching methods to apply in my work”). These themes, such as growing as a teacher, continuous development of teaching, new teaching methods, and better practice in class, were mentioned 24 times. The frequent appearance of these types of items indicates that our teachers were quite motivated and interested in developing their teaching in an abstract way. Specific teaching skills were also mentioned but were less apparent in the responses.

Content knowledge was also an interest of our teachers, which is highlighted by the second and third columns of Table 2. “Development of content knowledge” and the more specific “interest in the project themes” indicate that the content of a professional development course was very important for the teachers. The content in IRRESISTIBLE was

<table>
<thead>
<tr>
<th>Development of teaching materials</th>
<th>Interest in the project themes</th>
<th>Development of content knowledge</th>
<th>Collaborative aspects</th>
<th>Personal preferences</th>
<th>Student engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>14</td>
<td>12</td>
<td>9</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Continuous development</td>
<td>Science in society, RRI</td>
<td>Content knowledge</td>
<td>Being part of a team</td>
<td>Interested in new things</td>
<td>Engagement of talented students</td>
</tr>
<tr>
<td>Growing as a teacher</td>
<td>Increase awareness of RRI and inquiry-based science education</td>
<td>Cutting-edge science topics</td>
<td>Being part of an international team</td>
<td>Personal and social aspects and interests</td>
<td>Engagement of students</td>
</tr>
<tr>
<td>Effective teaching</td>
<td>Interest in nanoscience</td>
<td>Everyday science</td>
<td>Contacting other teachers</td>
<td></td>
<td>Stimulating students’ interest</td>
</tr>
<tr>
<td>New teaching methods</td>
<td>Interest in interdisciplinary approaches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better practice in class</td>
<td>Engagement of research and education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Analysis of responses to the question “What are your reasons for participating in this project?”

Note. The themes that teachers came up with were put into six categories. RRI = Responsible Research and Innovation.
RRI connected with cutting-edge science topics, and this seemed to be an important reason for the teachers to participate. Teachers in general might view this type of content more critically, which entails an interesting element related to the diffusion of RRI: RRI might face less critique from early adopters than the remainder of teachers.

A wish to collaborate was also one of the emerging themes and was mentioned by nine teachers (e.g., “I am interested in using innovative themes in teaching while collaborating with motivated colleagues”). Teachers may find it difficult to find opportunities for collaboration during their regular school work. Professional development courses offer one way to address this need. The teachers also mentioned aspects that could relate to promoting RRI directly (e.g., “I think collaboration between schools, universities, museums, etc., could improve student learning about science”). One goal of RRI is to promote out-of-school learning, and some IRRESISTIBLE teachers also seemed to share this goal. The two final columns represent teachers’ interest in “personal preferences” and “student engagement,” which were the least mentioned categories in the open-ended questions.

Teachers’ expectations for the project were largely consistent with their reasons for participating—the teachers probably did not differentiate between the two questions when answering the questionnaire. New themes emerging from the second open-ended question included learning to build interactive exhibits, nice module for schools, motivating teachers, and developing students’ competencies. Because themes related to both open-ended questions and their occurrences were very much alike, with the exception of these four themes we do not present the full results for the expectations question.

It seems that the respondents were most of all looking to improve their teaching, grow as teachers, find interesting content for their students, and collaborate with other teachers. These themes, which arose from the open-ended questions, are to some extent analogous to the concern stages of the SoC questionnaire. Many information, personal, consequence, and collaboration concerns were mentioned in the open-ended questions as well as in the SoC questionnaire.

**Pre/post comparison**

As discussed in “Methods and Analysis,” 29 teachers completed the SoC questionnaire after participating in the PDP within the IRRESISTIBLE project; this was less than half of the 67 pretest teachers. This was because of difficulties coordinating data gathering in 10 countries as well as local education experts’ difficulty motivating the teachers to answer, especially if teachers were absent from the final meeting and were obliged to answer in their spare time. The sample was, however, big enough for us to get some idea of the effect of the project. In Table 3 we present the pre/post comparison in order to approach the secondary research question on the effect of professional development on concerns related to RRI teaching.

We can see from Table 3 that participation did not have much of an effect on teachers’ concerns expressed in the SoC questionnaire. The information and collaboration stages were the only stages in which the change was arguably significant ($t = -1.97$ and $t = -2.15$, respectively). However, because of a ceiling effect, the information and collaboration stages were slightly skewed and did not pass the normality test. Even though most of the results were nonsignificant, the direction of change was consistent in all stages. It is probable that with a
larger sample size the decrease in concern intensities would become significant. It is also interesting that mean differences and standard deviations were smallest in the personal, management, and consequence stages. This suggests that the respondents’ concerns were relatively static in these stages. In the next section we discuss the role of teacher professional development in the implementation of RRI teaching in schools.

**Individual statements**

Here we take a closer look at some of the individual items on the SoC questionnaire that revealed additional information relevant to the research questions:

1. In the management stage more than half of the teachers were concerned about time as a resource (Item 3; see the Appendix), and more than half were concerned about managing all that RRI requires (Item 13). It is evident that teachers were already busy with their work and that teaching RRI requires a lot of management.
2. Most teachers were favourable toward adding RRI into the curriculum (Item 11) and were also willing to discuss bringing RRI to schools (Item 10).
3. More than half of the teachers were concerned about students’ attitudes toward RRI (Item 1).

These individual items confirm the previously discussed finding that even though teachers viewed RRI as a challenging topic to teach management wise and consequence wise, they still viewed RRI as something that is possible to implement in schools. Finally, when looking at the individual items, we found that teachers appeared quite eager to collaborate with other teachers (Items 4 and 23). The vast majority of teachers we surveyed wanted to help and coordinate their efforts with their colleagues. This was also supported by the analyses of the concern profiles and the open-ended questions.

**Discussion**

The diffusion of RRI into European schools in one form or another is an important goal for the EU. Our research on teachers’ concerns about RRI teaching highlights aspects that are very likely to have a strong influence on this diffusion process. According to teachers’

<table>
<thead>
<tr>
<th>Stage</th>
<th>Mean difference</th>
<th>SD</th>
<th>SEM</th>
<th>t</th>
<th>Significance (two-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>−2.00</td>
<td>5.37</td>
<td>1.014</td>
<td>−1.972</td>
<td>.059</td>
</tr>
<tr>
<td>Personal</td>
<td>−0.61</td>
<td>2.62</td>
<td>0.494</td>
<td>−1.228</td>
<td>.230</td>
</tr>
<tr>
<td>Management</td>
<td>−0.89</td>
<td>3.08</td>
<td>0.583</td>
<td>−1.532</td>
<td>.137</td>
</tr>
<tr>
<td>Consequence</td>
<td>−0.71</td>
<td>2.64</td>
<td>0.498</td>
<td>−1.433</td>
<td>.163</td>
</tr>
<tr>
<td>Collaboration</td>
<td>−1.86</td>
<td>4.58</td>
<td>0.865</td>
<td>−2.147</td>
<td>.041</td>
</tr>
<tr>
<td>Refocusing</td>
<td>−1.11</td>
<td>3.57</td>
<td>0.675</td>
<td>−1.640</td>
<td>.113</td>
</tr>
</tbody>
</table>

*Note. The negative mean difference and t values suggest that concerns decreased in all stages. However, results are significant or close to significant only in the information and collaboration stages. Based on mean difference and standard deviation, the least amount of change was detected in the personal, management, and consequence stages. The information posttest was not normally distributed (Shapiro–Wilk test for normality). The collaboration pre- and posttests were not normally distributed (Shapiro–Wilk test for normality).*
concern profiles and responses to open-ended questions, our forerunner teachers viewed RRI as something that is possible, worthwhile, and even interesting to teach. The respondents were willing to find information, collaborate, and work on RRI teaching and believed that RRI can be interesting to many of their students.

The primary goal of our study was to identify forerunner teachers’ concern profiles related to RRI teaching. According to our results, the majority of these teachers appeared to focus on information and collaboration concerns at the beginning of the professional development course. Teachers were least concerned with personal issues and the management of practice. This finding is consistent with other studies (Overbaugh & Ruiling, 2008; Shoulders & Myers, 2011) on other educational innovations. However, the personal stage seems to divide teachers into those who are unsure of their capabilities and those who are not. Some teachers displayed many personal concerns that remained after the developmental period. The reason that teachers from the IRRESISTIBLE project, who are arguably more motivated and forward looking than the average teacher, tended to assume the moderate profile type of a Co-operator instead of an Overachiever or Ideal Implementer may arise from the novelty and ambiguity of RRI as an educational issue. Teachers have to make an effort to develop RRI teaching from scratch. Therefore, RRI needs to be contextualised among teachers in a way that enables them to resolve their information and personal concerns and move on from the Co-operator profile type.

These results were also supported to some extent by the responses to the open-ended questions. Teachers focused on teacher growth; content-related knowledge; and aspects of collaboration, such as being a part of a team. Teachers also mentioned the consequences for students in their responses. Through the open-ended questions, teachers also demonstrated a high degree of interest in the themes of the IRRESISTIBLE project and in developing themselves as teachers, as these categories were most often mentioned in teachers’ responses to the open-ended questions. The specific content and the opportunity to grow as a teacher could very well serve as the most important aspects of a PDP, as teachers mentioned many of these themes in their reasons for participating in the project and in their project expectations.

The diffusion of RRI teaching on a wider scale demands that teachers who are not forerunners adopt RRI teaching also. These teachers will most likely have more information, personal, and management stage concerns than the teachers in this study. The diffusion of RRI teaching requires that most teachers identify and resolve the potential practical pitfalls of RRI teaching. This further highlights the importance of contextualisation: Teachers want teaching innovations that are relatively straightforward to use and modify for their purposes.

The secondary aim of our study was to identify the effect of the PDP, carried out within the IRRESISTIBLE project, on teachers’ concerns about RRI teaching. We expected that negative concerns would decrease and positive concerns would increase in a manner similar to earlier reports on the effects of PDPs (Liu, 2005; Overbaugh & Ruiling, 2008; Shoulders & Myers, 2011). To our surprise the impact remained very small, as the difference in all stages remained statistically questionable. The plausible change was closest to significant in the information and collaboration stages, which indicates that some of the participants fulfilled their information and collaboration needs about RRI teaching during IRRESISTIBLE. According to the $t$ test, the personal, management, and consequence concerns were all relatively far from a significant change and had small average mean differences and standard deviations. This suggests that concerns in these stages in the case of RRI teaching are quite static and perhaps difficult to resolve. A larger sample size would
shed more light on whether these assumptions are true or not. It is possible that the concerns of the IRRESISTIBLE teachers remained unresolved throughout the course. It is also possible that, like planting a seed, the effect of a professional development course grows significant only gradually after the course, through continuing work on contextualising RRI issues afterward.

**Different approaches to RRI teaching**

Although the educationally significant issues of RRI have been applied to teaching via several EU-funded development projects (ENGAGE, IRRESISTIBLE, RRI Tools), consensus on the conceptualisation of RRI teaching has not been established in the literature. In order to achieve this goal, substantial and impactful research is needed in addition to the few studies conducted so far (Blonder, Zemier, & Rosenfeld, 2016; Okada & Bayram-Jacobs, 2016; Ratinen, Kähkönen, Lindell, & de Vocht, 2016). For example, should teachers teach RRI as a normative set of values, or should they support students in their own meaning making and to come up with their own set of values considering the societal aspects of research and innovation? This relates to the question of whether RRI should be taught explicitly or implicitly to students. Both approaches have been tried in the IRRESISTIBLE project. Some CoLs chose to teach RRI explicitly as a normative set of key points, for example, making students study the EU documents and prepare presentations about each RRI key point as such. Some CoLs combined RRI with a context in a more implicit way. For example, in Finland RRI was embedded in the context of climate change, and students had to consider the risks arising from the contradicting interests of different societal actors. Students ages 11 to 13 years answered letters from various fictional experts around the world.

To contextualise the normative aspects of RRI teaching and to support students’ agency, teachers should give students opportunities to come up with a diversity of viewpoints and solutions to societal problems. We suggest that such classroom discourse would render RRI teaching toward the socioempirical version of RRI (Ruggiu, 2015). One way to apply this in teaching is to present students with an RRI-related conflict of interest and let students assume different societal roles. Then students can come up with different solutions and reasoning for the actions of various members of society. In this way students could create a dynamic view on how the RRI-related values of society can be formed. Such a socioempirical way of teaching RRI is not possible if RRI is presented explicitly to the students as a set of key points. Teachers can, however, use the key points as a loose guide when planning their lessons while not presenting them directly in the teaching/learning content.

The way RRI is presented to teachers and curriculum makers is very important also. The diffusion of RRI in classroom practices will most likely stall if it is just added to the curriculum without proper investments in professional development and the development of educational approaches. The problem is that RRI is an unknown and abstract concept for the great majority of teachers, and teachers will most likely shy away if it is presented as another EU framework or policy. Instead, to facilitate the process RRI should be combined with pedagogical themes teachers and curriculum developers are already familiar with, such as Science in Society, Nature of Science, inquiry-based learning, ethical issues, sustainable development, and gender issues. Although links clearly exist between RRI and these concepts, they have not yet been defined by the EU or scholars of the field.
Given the importance of the concepts, it is encouraging that at least the forerunner teachers in this study viewed favourably the incorporation of RRI into curricula. Addressing RRI specifically in the curriculum would justify teachers’ efforts and time spent on RRI teaching. However, the well-known challenges of introducing unfamiliar top-down concepts to curricula and teachers still remain. For example, difficulties in teaching information and communication technology (ICT) and some solutions for them were identified already at the turn of the century (Newhouse, 2001), but teachers still face many obstacles (e.g., with insufficient skills in ICT) and might even have negative attitudes toward this concept. Incorporating RRI into curricula would probably work better with careful framing and connection with established concepts as described before.

**Notes on validity, further research, and the development of C-BAM**

This study highlights the need to develop C-BAM further to be used as a tool for more detailed understanding of different concern profile types. Although C-BAM appears to address some of the necessary factors related to teachers’ concerns, the instrumentation of it, the SoC questionnaire, did not differentiate teachers enough in our results. Also, too many of the questionnaire items have a ceiling effect in the case of an innovation like RRI teaching.

Some concern stages tend to yield high intensities not because teachers actually have these concerns but because certain kinds of items are not balanced across stages. For example, the management stage includes many items starting with “I am concerned . . .,” which often yield a relatively low concern intensity score. In contrast, the information stage has many items starting with “I would like to . . .,” which often guide answers toward a higher intensity score. Also, the latter formulation often results in a ceiling effect.

Researchers can improve the questionnaire by developing questionnaire items that divide teachers into those who agree and those who disagree. Only then can experts expect to find different kinds of concern profiles with statistical methods, such as cluster analysis. The formulation of items in different concern stages should also be more homogenous in order to improve the comparability of different concern stages. This direction, for the future of C-BAM, is something we are currently aiming for in our subsequent study on concerns related to RRI teaching (de Vocht and Laherto, in press).

Other issues with validity stem from the diversity of teachers included in this study and the various different languages used in the questionnaire. For example, the word concern is not easy to translate into Finnish, as the translated term carries a more negative meaning. Therefore, various alternative phrasings had to be used for different contexts and languages. The number of teachers included in our study from each country was also quite small, which eliminated the possibility of making extensive comparisons. Because the nature of this study was explorative instead of comparative, the limitations are not critical. However, the second step of the project will involve a SoC questionnaire revised on the basis of these results, much more teachers, and comparative samples.

The work of a teacher involves continuous adoption of new teaching methods, ideas, and experimentation in practice. Attitudes toward new ideas and topics represents one of the most important qualities of an effective teacher. Teachers who participated in this study are more likely more experimental than teachers on average and viewed the themes of the project quite positively. RRI seems to be a valid and inspiring teaching subject for this group of teachers, who are also likely to be forerunners in the next phases of the
innovation. Moreover, the exploratory study reported here paves the way for the currently ongoing second phase of the project. This latter phase involves a much larger sample that is representative of European teachers, the final adopters of the innovation. Their concerns are expected to differ from those of the forerunner teachers included in this study.

Our exploratory work in profiling teachers’ attitudes toward RRI will promote the diffusion of RRI teaching in Europe and elsewhere. It also contributes to a general understanding of teachers’ concerns in educational innovations and the use of C-BAM in studying them.

Acknowledgements

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Disclosure statement

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References


Appendix

**Questionnaire Items Organised Based on Their Concern Stage**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>5. I have a limited knowledge of RRI.</td>
</tr>
<tr>
<td></td>
<td>12. I would like to know what resources are available to teach about RRI.</td>
</tr>
<tr>
<td></td>
<td>29. I would like to know more about RRI topics myself.</td>
</tr>
<tr>
<td></td>
<td>30. I would like to know more about the educational aspects of RRI.</td>
</tr>
<tr>
<td></td>
<td>33. I have learned enough about RRI in my teacher education.</td>
</tr>
<tr>
<td></td>
<td>6. I am concerned about a possible conflict between my interests and my responsibilities.</td>
</tr>
<tr>
<td></td>
<td>13. I am concerned about my ability to manage all that teaching about RRI requires.</td>
</tr>
<tr>
<td></td>
<td>17. I am preoccupied with things other than teaching about RRI.</td>
</tr>
<tr>
<td></td>
<td>19. I don’t spend much time thinking of teaching about RRI.</td>
</tr>
<tr>
<td></td>
<td>27. I would like to know how my role will change when I teach about RRI.</td>
</tr>
<tr>
<td>Management</td>
<td>3. I am concerned about not having enough time to teach about RRI well.</td>
</tr>
<tr>
<td></td>
<td>21. I am concerned about time spent working with practical problems related to teaching about RRI.</td>
</tr>
<tr>
<td></td>
<td>22. I would like to know what teaching about RRI will require in the immediate future.</td>
</tr>
<tr>
<td></td>
<td>24. I would like to have more information on time and energy commitments required by teaching about RRI.</td>
</tr>
<tr>
<td></td>
<td>32. I think teaching about RRI is not possible in school.</td>
</tr>
<tr>
<td>Collaboration</td>
<td>4. I would like to help my colleagues in their teaching about RRI.</td>
</tr>
<tr>
<td></td>
<td>10. I would like to discuss the possibility of teaching about RRI.</td>
</tr>
<tr>
<td></td>
<td>23. I would like to coordinate my efforts with others to maximise the effects of teaching about RRI.</td>
</tr>
<tr>
<td></td>
<td>26. I would like to use feedback from students to change the module developed during the IRRESISTIBLE project.</td>
</tr>
<tr>
<td></td>
<td>31. I would like to know more about out-of-school learning opportunities for teaching about RRI.</td>
</tr>
<tr>
<td>Refocusing</td>
<td>7. I am concerned about the need to revise my teaching.</td>
</tr>
<tr>
<td></td>
<td>11. I am in favour of including RRI into the curriculum.</td>
</tr>
<tr>
<td></td>
<td>16. I would like to revise the approach of teaching about RRI.</td>
</tr>
<tr>
<td></td>
<td>18. I would like to modify the use of RRI teaching material based on the experiences of students.</td>
</tr>
<tr>
<td></td>
<td>25. I would like to determine how to develop the approach of teaching about RRI.</td>
</tr>
</tbody>
</table>

Note. RRI = Responsible Research and Innovation.

*Reversed items.