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In a world where global challenges and advances in technology bring both uncertainty and

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Contents

The Royal Society of Chemistry (RSC) has a proud heritage of recognising excellence in chemistry, extending back to its first Faraday Medal in 1869. However, science and society are continually evolving, and the RSC understands that its recognition portfolio needs to be responsive to the changing landscape. Over the decades there have been many additions — most recently, for example, the Inclusion and Diversity Prize first awarded in 2017 — but these have not been underpinned by a clear set of principles or priorities, so in 2018 I was asked to chair a review of recognition that might articulate a systematic strategic approach.

I was delighted that we were able to assemble an outstanding Review Group with expertise in academic and industrial chemistry, research and teaching, biotechnology, biology and psychology, so that we could examine basic principles and cover the entire range of interests of the Royal Society of Chemistry and its members. We have consulted widely, asked fundamental and di□icult questions about the purposes of recognition, and have made some recommendations that may prove controversial.

The review was overseen by an independent Review Group, which brought together individuals from within and outside chemistry with a range of experience and expertise. The group considered the literature, information about the current RSC prize and award portfolio and views articulated in a broad consultation process described in more detail in the Methodology section. Informed by this range of evidence and perspectives, the Review Group discussed the overall framework of principles, recommendations and options in a set of two full meetings as well as through phone conversations and email input.

The membership of the Review Group was:

- Prof Jeremy Sanders CBE FRS (Department of Chemistry, University of Cambridge) - Chair
- Dr Angelo Amorelli (Group Research, BP)
- Prof Tom Brown (Department of Chemistry, University of Oxford)
- Prof Richard Catlow FRS (Department of Chemistry, University College London)
- Dr Roger Highfield (Science Museum Group)
- Prof Nazira Karodia (Faculty of Science and Engineering, University of Wolverhampton)
- Prof Anne Ridley FRS FMedSci (School of Cellular and Molecular Medicine, University of Bristol)
- Dr Kristy Turner (School of Chemistry, University of Manchester / Bolton School)
- Prof Essi Viding (Clinical, Educational, and Health Psychology Research Department, University College London)
- Prof Dr Helma Wennemers (Department of Chemistry and Applied Biosciences, ETH Zurich).

One of the Royal Society of Chemistry's roles for the chemistry community is to reward and recognise excellence. As we have improved our understanding of excellence over time, we must now take action to improve how we reward and recognise modern scientific excellence. With this review, and our action plan based on its findings, we are taking a decisive step forward in recognition in science.

Recognition in science has its roots in the 19th century, but today we understand that great science depends on so much more than individual endeavour and is about more than

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iii. Education, engagement and innovation

These spheres are currently underrepresented in our recognition o□ering. Increasing recognition in these areas would reflect their importance in the modern world. Prizes could be used here to develop case studies, or share and highlight good practice. We should be creative and make sure that the ‘prize’ is relevant and meaningful for winners.

iv. Breakthroughs and emerging areas

Respondents to our survey named significant breakthroughs as the number one outcome meritorious of recognition by the RSC. It is also important to recognise contemporary and emerging science, including in areas that lie at or across interfaces between disciplines and sectors.

Recognition should demonstrate the many ways in which chemistry contributes to humanity

We have an opportunity to use recognition to increase the visibility of the chemical sciences beyond the scientific community. Prizes can be a mechanism to ility o to recognise cow adr winner

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Building on the Purposes of Recognition the Review Group articulated eleven overarching and inter-related Principles of Recognition for the RSC.

P1. Recognition should be of excellence

Defining excellence is di□icult even though each of us, intuitively and subjectively, can o□en quite easily recognise it. There is excellence in di□erent domains, achievements, roles and contributions. Excellence cannot be judged based on metrics or quantitative data alone. It should be judged against written criteria that are flexible enough to allow for expert review and judgement and are relevant to whatever is being judged.

P2. Recognition should reflect the diversity of individuals and teams contributing to science

Diversity should be front and centre in the thinking about every aspect of recognition programmes, from articulating the fundamental purpose of a prize to nomination and selection processes. The connections between recognition and diversity play out at every level from the individual to the systemic. It is vital to consider protected characteristics like disability, ethnicity, gender, religion and sexual orientation as well as dimensions such as culture, personality, places of employment, socioeconomic background and values.

P3. Recognition should reflect the diversity of ways in which people contribute to science and society

This includes diversity of roles and jobs, for example as communicators, school teachers, technicians and scientists working in companies and academic institutions. It also includes di□erent activities such as outreach, leadership, mentoring, research and development, teaching and volunteering.

P4. Recognition should support scientists at all career stages and in di erent types of careers, with recognition tailored to di erent career stages

There are many career paths, with increasing variety as people change sectors and roles, take career breaks and work in one or more part-time roles during the course of their careers. Career stages or steps vary for di□erent domains.

P5. Recognition should be used to celebrate the value of science to society

Publicity and celebration events can deliberately aim to engage a range of audiences, with an ambition to inspire or change perceptions. Winners are role models, ambassadors and advocates within and beyond science. Projects and achievements are case st0 (ar)-and oenGBoSCT-a7 >>BDC(en-GB) -0.004cen-Geludvoyon1>>BDnudal (an delii0 (ar)-andnudvis_1 1 Tf)10 (eer s)20 (t)20 (ag)och

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Figure 1: Dimensions of excellence

PRINCIPLES

WHY?

- What is the purpose (or purposes) of our recognition portfolio?
- What audiences do we want to reach and why?

WHAT AND WHO?

- What domains do we want to recognise?
- What types of excellence do we want to recognise?
- Are we recognizing a person/team, an outcome or both?

HOW?

- How can we most effectively recognise each of the different domains and types of excellence in order to achieve our purpose(s)?
- How will we most effectively celebrate and publicise the different achievements and contributions we recognise?
- How will we organise ourselves so that the recognition portfolio we have designed achieves its purposes?

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Figure 2: Strategic design of a recognition portfolio. Principles of recognition are embedded at each stage of the process

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Incentive prizes

There has been a growing trend to encourage innovation through the o□er of large cash prizes.[8] Examples of this include prizes o□ered by the charitable X Prize Foundation and the Gates Foundation. In 2007, McKinsey reported that there were over 200 prizes worth over $100,000. Incentive prizes are not new, an early example being the Longitude Prize established in 1714. Both governments and companies are now following this model with the intention of spurring innovation. In 2009, McKinsey and Company reported that since 1991 a change had occurred with prizes announced shi□ing from rewarding excellence to those providing incentive for specific innovations.[9] The work by McKinsey indicated the use of philanthropic prizes were more e□ective than other instruments in situations where three conditions were met: (1) a clear objective; (2) a large population of potential problem solvers and (3) a willingness of participants to share the costs. In the case where these conditions are not being met, McKinsey suggested that alternative mechanisms such as grants and other prize mechanisms should be considered.

Recognition is associated with certain duties or expectations for recipients (Principle 9)

Frey has published[10] on the idea of giving (supply) and receiving (demand) for awards, setting out how "The demand for awards relies on an individual's desire for distinction, and the supply of awards is governed by the desire to motivate." He posits that "Awards can be seen as a device that, like monetary income and intrinsic motivation, motivates individuals to exert e ort (Tait & Walker, 2000). The institution bestowing an award wants to induce the recipient to act in its interests. The relationship established has the character of a psychological contract involving a tacit and expectloSpan meywy0.1 ars g EMC /Spaolving.2 zten-GB□□device thatth (ec)15 (ontr)10 (act inbno) /Span <</Lng (en-GB)/MCID 587 >>BDC

The survey also provided valuable insights into perceived barriers to recognition, many of which the Review aimed to address through its recommendations.

Table 3: Source: RSC Review of Recognition Programmes Survey,

Taking the survey data, literature review, workshop and interview perspectives together, the review proposed four important Purposes of Recognition by the RSC. For each purpose there is an intended primary beneficiary.

The purpose and objectives of recognition by the RSC
Why have recognition?
Progression, validation, encouragement and reputation for individuals and teams (Awardee benefits)
Recognising excellent chemical

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Gender

Whilst there has been a consistent but gradual improvement over the past 5 years[17], likely related to RSC interventions, there was a view that the low percentage of female nominees in some areas has been a key factor in limiting the percentage of female winners, particularly for later

Leadership

Leadership was selected by 46% of survey respondents as meriting recognition, rising to 67% among the respondents who identified themselves as senior managers (see Figure 10). The question of leadership arose in di erent ways through interviews, roundtable discussions and workshops. There is an opportunity for the RSC to articulate its own view on what e ective leadership in science looks like, why

Response	Academia	Education	Industry
Don't know	5%	7%	8%
Very inaccessible	10%	18%	14%

72%

Engagement and outreach

There was a strong view in the consultation that engagement with a variety of di□erent audiences is important for science. People used the word “outreach” to cover a range of activities from sustained outreach partnership projects between schools and universities to public and policy engagement activities by individual researchers in universities or companies. Some individuals are employed in specialist educational outreach or science communication roles, others do “outreach” associated with another role, and others – for example, students and retired people – do outreach voluntarily alongside other commitments.

Outreach and engagement activities vary widely, depending on the purpose of the activity. Audiences vary accordingly and include members of the public, teachers and school students, and policymakers. Some of the reasons why outreach and engagement were viewed as important were:

- Encouraging and inspiring people to study chemistry in school, college or university
- Widening the diversity of people studying and working in chemistry both by ensuring audiences are diverse and by ensuring that the people doing outreach reflect diversity in a broad sense, including protected characteristics, socio-economic and cultural background, and diverse roles and career stages.
- Encouraging retention of professional chemists
- Raising the profile of chemistry within STEMM
- Raising the profile of chemistry with public audiences
- Raising the profile of chemistry with policymakers and politicians for the purpose of securing funding and support for chemistry education, innovation and research
- Creating a way in which professional chemists “give back” to society by sharing their passion and excitement about chemistry, and sometimes the latest advances and discoveries.

Outreach featured less strongly in the survey than in interviews and workshops. It emerged eleventh in the activities selected by survey respondents as meriting recognition, with people working in education most likely to select outreach.

Views were mixed on whether there should be stand-alone recognition for outreach or whether it should be included in criteria for all other recognition. A sense that outreach should be a requirement for all prizes came from seeing this as a way of incentivising people to do outreach, and also as a way of tackling perceptions in acadachuBDC 0 -ctebd less >>B

Innovation

The review heard that the RSC already recognises innovation, but that there is scope to do this more e□ectively. The RSC Emerging Technologies Competition is itself an innovative recognition mechanism giving profile to individuals and companies. Participants range from small companies participating in the competition to large companies who sponsor the competition and provide mentoring and advice for participants and winners.

There are some RSC prizes and awards for innovation and/or for industry, but the sense from the consultation was that the objectives for these prizes and awards are unclear. Related to this is the view that the criteria for these awards are broad, ambiguous and not always relevant to the area being recognised.

It is important for the RSC to clarify what it is aiming to recognise and why. “Innovation” and “industry” are both very broad categories and, while they overlap, are not the same thing.

The Review heard that, even for individuals working for large companies which have well-developed internal recognition schemes, recognition by the RSC can be important. The purpose of recognition could be to show that the RSC understands and values the work of its members based in industry, to support individual careers, and/or to develop role models and case studies.

Another purpose of recognition is to foster innovation by highlighting, supporting and connecting companies. In this case, the prevailing view was that the RSC should focus on small companies, as in its Emerging Technologies Competition.

There are also opportunities to recognise and celebrate innovations and technologies. These will involve both single subject and multidisciplinary teams that have played a key role in the development of a commercially successful technology process, product or service. Depending on the purpose of the recognition, teams could be within companies and/or collaborations between multiple partners across academia and industry. In this case, team members may be based in small, medium and/or large companies and, as for other domains, may include individuals in a variety of roles and at di□erent career stages.

Even for large companies, innovation awards can be valuable because technology teams within companies generally do not publish their results and there are fewer external measures of excellence. Recognising innovations and technologies provides an external benchmark of excellence and credibility, which can be useful for the profile of R&D units within a large company and for the company itself in the wider environment.

As part of the consultation, there was also significant discussion about the complexity associated with recognising applied research and innovation in industry and academia. Taking the example of the current RSC Applied Catalysis Award, there were differing perceptions about what “applied” means. These fell into two categories corresponding broadly to more academic and industrial perspectives, both of which are important. The first is that the award recognises research that aims to, or has the potential to, achieve or enable a particular application. The second is that the award recognises research that has demonstrably been applied in a successful process or product.

More generally, RSC prize rubrics and criteria should make clear to nominators whether a prize aims to recognise promising potential, delivered results, or more flexibly, research and innovation across the full spectrum in a science and technology area. This will depend on the purpose of the prize.

As in other domains, there are opportunities for the RSC to recognise di□erent types of excellence. In the survey the highest proportion of respondents selected significant breakthroughs and innovations as worthy of recognition, with managers leaning slightly more towards significant breakthroughs and practising chemists leaning more towards innovation. A greater proportion of managers selected leadership and impact, compared with senior researchers and researchers who selected mentoring, positive societal impact, integrity and responsible science.

> “In companies you can get promotion if you work hard, this [recognition from the RSC] is totally di□erent from what you get from your company.”
>
> Review of RSC Recognition Programmes interview

> “Industry sometimes gets forgotten, so [we] need clearer industry awards for industrial chemists/researchers.”
>
> Review of RSC Recognition Programmes interview

> “The RSC is focussed on recognition for chemists working in academia or research; more focus should be placed on those working in industry and other organisations.”
>
> Review of RSC Recognition Programmes survey response

> “Prizes for good ideas… these sessions are a really good idea for early stage companies.”
>
> Review of RSC Recognition Programmes interview

Currently within the RSC portfolio, only the prizes and awards for research have career stage stratification. A recurring theme in the consultation was that the RSC should extend opportunities at di□erent career stages to other domains, particularly for early career chemists.

There was universal agreement on the importance of supporting and encouraging early career chemists. The overall sense was that this is working well for the prizes for research.

The review heard that the RSC should actively monitor diversity for the early career prizes and awards.

In interviews, workshops and roundtable discussions, the review heard that the RSC should expand its recognition opportunities for people at the mid-career stage, because it is important to encourage and recognise people throughout their career. This view was reflected also in the survey (Figure 11). There was a sense that the 5-year window used in the eligibility criteria for prizes such as the Corday-Morgan Prize is too narrow. A 10-year window would create greater di□erentiation between the early and mid-career prizes and extend the period of opportunities for mid-career researchers.

In the case of prizes for people at an established or very late career stage, the Review heard that it is appropriate to use minimum ages in defining career stages. It is important that these awards recognise recent work rather than lifetime achievement. There was also a sense that the expectations on recipients of established or very late career stage awards may be di□erent as the purpose of the prize may be di□erent, shi□ing from primary benefit to the awardee at an early career stage, to benefits to science, society and the RSC at later stages.

There was a strong view that the RSC should avoid a “prize escalator” where individuals who win prizes at the early career stage tend to be those that win prizes at mid and established career stages. People flourish professionally in a demonstrable way at di□erent points in their careers. This is for many di□erent reasons, including di□erent career paths, di□erences in the type of scientific activity that an individual pursues, and the many di□erent types of support and barriers people experience along the way. It is important that recognition by the RSC encompasses the totality of excellence, and that the RSC is proactive in showing that it is aware that excellence may be manifest at di□erent points in a career.

The review also heard a degree of frustration that some individuals “collect gongs” and win numerous prizes and awards. There are of course extraordinary individuals who are excellent in multiple domains and in multiple ways and will rank top of the list for multiple prizes. This is not necessarily an issue, especially when the winner fulfils the expectations that may be associated with winning prizes.

However, there was a sense that where possible and in line with the purpose of the recognition, extending recognition to a broader group of individuals may be a more strategic use of the resources – both RSC financial resources and volunteer time – invested in running a recognition programme. This is because it would expand the pool of role models, ambassadors and advisors working for the wider benefit of science. Broadening the pool of winners could also work positively to encourage people who have not previously been nominated or made nominations to participate in prize schemes.

> “Early career is the only group consistently singled out for special treatment.”
> Review of RSC Recognition Programmes survey response

> “We are not doing enough, most of the Division recognition goes to late career [scientists].”
> Review of RSC Recognition Programmes interview

> “I don’t think the recent changes are quite right. Early career up to 10 years, mid-career up to 15 years – this implies the mid-career window is 5-years, which seems a bit short and means mid-career is not well represented.”
> Review of RSC Recognition Programmes interview

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The purpose of each prize again emerged as aRcrucial considera]TJ EQion. If the purpose of a prize or award is to

Hierarchy & portfolio structure

Ideas about hierarchy and recognition in a general sense arose in di□erent ways in the consultation. One idea is that of bronze, silver and gold prizes corresponding to excellence at di□erent levels of contribution defined by, for example, increasing breadth across a domain or increasing scale of impact. There can also be hierarchy associated with advancing career stages, allowing also more prizes at the early career stages for the purpose of supporting careers.

Views about the importance of hierarchy were, for some, related to perceptions about prestige. The latter can arise in di□erent ways, including from the profile given to winners with di□erent audiences, in some cases as the result of deliberate e□orts by the organisation awarding the recognition. Alternatively, a prize may be considered to be very prestigious within a small community and the prestige associated with recognition by expert peers. Views on the desirability of hierarchy in prestige naturally depend

Lecture tours

Feedback from winners was that university lecture tours are a very positive and valued aspect of the prize, although not all prizes have associated university lecture tours.

For prizes where the RSC arranges university lecture tours, winners saw their visits as beneficial for making connections, raising their profile and also learning about di erent universities around the UK. Lecture tours are also beneficial to the departments that host winners.

There was a view that international winners should visit a wide range of institutions because part of the purpose of the lecture tours is to give students, faculty and other sta at universities the opportunity to hear presentations by and to interact with leading international scientists. Winners also reported valuing the opportunity to meet with early-career scientists including PhD students and post-doctoral researchers.

Benefits included making links with potential post-docs and the opportunity to advise UK-based PhD students and post-docs about research systems in other countries.

Whilst the lecture tours were widely valued, flexibility is important. The RSC should be mindful that for some individuals the requirement of a lecture tour that can extend over one week may be limiting the diversity of nominations, for example for individuals with caring responsibilities or people with disabilities for whom travel is challenging.

Depending on the purpose of the prize, there may be opportunities to extend the concept of lecture tours beyond universities to schools, science museums and companies. There may also be opportunities to make prize lectures available more widely, for example by streaming, broadcasting and recording them.

> “ [The most valuable element of winning was] the opportunities for networking and also the lecture tour.”
>
> Review of RSC Recognition Programmes survey response

> “ When I won the award there was no travel fund for lectures, I felt that was a bit of a shame.”
>
> Review of RSC Recognition Programmes interview

> “ Speaking opportunities are valuable: both for a department bringing in a prize winner, and also visiting institutions as a prize winner.”
>
> Review of RSC Recognition Programmes interview

Lists

The Review heard some support for the idea of publishing lists of shortlisted nominees for prizes and awards as a way of broadening recognition to a greater number and more diverse group of people each year. Overall the view was that for individual prizes this may deter people from putting themselves forward, but that it would be sensible to publish non-ranked shortlists for team or project awards based on collective input.

There was some appetite for the idea of recognising cohorts

Prospective and retrospective prizes

RSC prizes and awards currently recognise past achievement, which was considered important in interviews, workshops and the survey (Figure 13).

There was also support in the survey for the idea of recognising potential and incentivising behaviours or projects, although this did not emerge as strongly in interviews and workshops. The recognition mechanisms are likely to be di erent and the RSC may wish to amplify current schemes such as its Emerging Technologies Competition, Outreach Fund and Researcher Mobility Grants. There was little support for challenge-based large cash prizes, but several consultees referred to prospective prizes such as the Royal Society Rosalind Franklin Award.

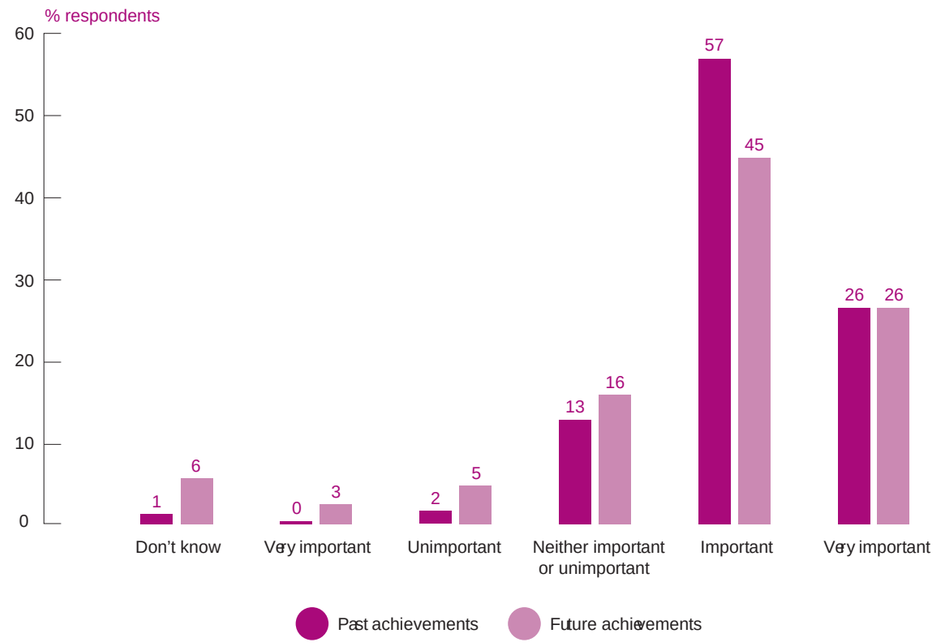

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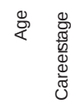
Figure 13: Source: RSC Review of Recognition Programmes Survey, 2018. Survey questions: How important or unimportant are prizes and awards that recognise past achievements; How important or unimportant are prizes and awards that recognise future achievements? Data shown from all who responded to the question (N = 1823).

How should the RSC organise its recognition programmes?



“ Not passing on the name of the nominator to awards committees was a positive development.”

Review of RSC Recognition Programmes workshop – RSC Division Council

“ On self-nomination – the plus side is that it may mean that someone who doesn’t want to ask to be

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Judging

The review heard that judging and eligibility criteria should be clear, transparent and relevant to the domain and type of excellence being recognised. In particular, the RSC should continue to its work to ensure criteria are relevant for awards aiming to recognise people working in education and industry, and in a range of di□erent roles.

There was a strong view that criteria should not be based on metrics.

Eligibility criteria for career-stage related prizes should provide clear guidance regarding career breaks and non-traditional career paths, encouraging and normalising nominations from individuals with diverse career trajectories.

The review heard some concerns about judging panels in connection with diversity. Some people expressed the view that the composition of judging panels should prioritise diversity, others that it should prioritise expertise in the area of excellence being judged, and others that panels should balance both insofar as is practical or possible.

There was also a concern that prioritising diversity on judging panels may make the pool of individuals from under-represented groups eligible to nominate or be nominated even smaller because panel members can neither make nominations nor be nominated for awards. Furthermore, such individuals are frequently under more pressure than others to participate in appointment or grant committees and similar activities in other arenas.

While the review found no evidence of bias, nepotism or impropriety in judging, there is room for the RSC to set out its judging process more clearly in the interests of accessibility and transparency. For example, it would be valuable to describe in one place who is eligible and ineligible to nominate and be nominated, what the process is for judges to declare conflict of interest, and the process for reviewing and discussing nominations.

Recommendation 11: in line with Principle 8, future recognition by the RSC should respect the history of the current RSC prizes and awards, but the structure of the recognition portfolio should be rationalised and clearly articulated.

The review has identified a number of recommendations relating to the size, structural clarity and naming of prizes of the portfolio.

- The RSC should reduce the size of its recognition portfolio.

Figure 16: Methodology for Review of RSC Recognition Programmes

We issued the survey via email to RSC members and non-members. Key target audiences included teachers, academics