IOP Institute of Physics Scotland

Independent Review of Qualifications and Assessment in Scotland

Phase 3 Survey response

Introduction

The Institute of Physics (IOP) Scotland welcomes the opportunity to respond to Phase 3 of the independent review's work.

Responses to consultation questions

Question 1:

1. (a) Do the three areas described above [i.e. *Subjects or Curricular Areas*, *Learning in Context* and *A Personal Pathway*] **offer learners the potential to gather and reflect a broader range of achievements important for their future progress?**

(b) Is there anything you would add or delete?

The areas set out in the model are comprehensive, so it is unlikely there would be anything else meaningful to add. Accordingly, this model offers the potential to gather and reflect a broad range of learners' achievements. However, the issue of how effective the model will be depends upon how the achievements are recognised in each area and the comparative importance between the three areas in any assessment of ability.

2. What are your views on the proposals for recognising achievements in subjects/curricular areas?

Retaining subjects as a core element of both the curriculum and qualifications and assessment model is vital not only for developing distinct knowledge but also to enable the development of skills which build upon that knowledge.

Subjects taught in school have developed over a long period from the wide span of human knowledge. We often think of classical physics as beginning with Newtonian mechanics, but astronomy was taught in schools in Alexandria, Egypt since at least 300 BC.[1] Since the development of the scientific method under Sir Francis Bacon in the early 17th century, however, teaching science has not only involved covering substantially more broad and well-developed concepts but also has followed an empirical path in determining *how we know* what we know. The move to universal classification of knowledge democratised and socialised learning, not only making learning more consistent and collaboration easier, paving the way for an information-based society, but this also made consistent assessment much easier too.

[1] e.g. "The evolution of school subjects", E L Crabb, in *Peabody Journal of Education* (1928) vol 5, 236–245

The analogy of building blocks is relevant because knowledge is accumulative. As physicist Sir Isaac Newton observed, even in the 17th century, seeing further is possible when – metaphorically – "standing on the shoulders of giants". The extent to which this matters varies by subject, but it is especially important in the STEM subjects, including physics. Most physics courses begin with classical Newtonian mechanics because they describe forces which can be observed in everyday situations. Only then do they go on to consider that the same force which "pulls" an apple to the ground also holds planets in orbit around the Sun. Indeed, it is hard to imagine that advanced concepts such as relativity or quantum theory could make sense without first understanding core aspects of matter and energy.

Not only this, but recent developments in cognitive science and developmental psychology have confirmed that contextual details matter significantly in what learners retain, and retention is an essential precursor to applying knowledge in different fields.[2] So a knowledge-rich, subject-based approach both to the curriculum and qualifications and assessment models is the best way of both making and recognising progress in learning.

This approach has notable positive effects. First, it ensures learning and recognition can occur in ways which are more familiar to tertiary learning institutions and potential employers and more readily implementable in further study, research and workplaces. Advanced levels of scientific knowledge will be vital to develop and utilise the technologies which we will need to grow our economy and address complex social challenges, such as tackling climate change and responding to global threats such as the COVID-19 pandemic. But a more scientifically literate population will also matter for negotiating far-reaching technologies such as generative AI and mitigating risks such as disinformation and the exploitation of personal data.

Second, it enhances the potential of education to act as a social leveller and to promote social cohesion because every learner, from whatever background, has access via the school system to the same knowledge and therefore has analogous opportunities to succeed in their lives. Knowledge-based learning and assessment is accordingly substantially helpful in closing the poverty-related attainment gap.

Third, this approach is not only important for learners' outcomes, but also for the practicality of teaching and organising of schooling. Subject knowledge is a core element of successful teaching,[3] and this begins with the education which the next generation of teachers receive in their own school learning.

Fourth, there is increasing evidence from other countries which have moved away from subject and knowledge-based learning that learner outcomes have not only not improved, but instead have declined, and indeed attainment gaps have widened.

---

2 e.g. *Why Knowledge Matters*, E D Hirsch Jr (2016).

3 See *Subjects Matter*, Institute of Physics (2020).

Fifth, clear subject labels such as "physics" helps to give learning a clear identity; it is not clear what the effect would be on participation in branches of learning if these were not clearly recognised in the curriculum or in qualifications and assessment. Although physics is a comparatively popular subject in Scotland (the ninth-most popular subject at National 5, eighth-most popular at Higher, fifth-most popular at Advanced Higher)[4] it suffers from persistent perceptions among pupils that it is (or can be) unusually complex, irrelevant to daily lives or uninspiring, although there are major differences of perception between those who take the subject and those who do not. These perceptions may adversely affect its resilience as a subject if it ceases to be recognised as easily.

3. What are your views on the proposals for recognising achievements in knowledge and skills in action?

We recognise the potential value in recognising these achievements. Learning in a practical context – for example, through experimentation, observation and recording – is a significant element of teaching science and developing skills to deploy beyond the classroom. Hands-on opportunities can greatly enhance understanding and motivation – an approach embodied in many classrooms and beyond, such as in science centres.

However, as noted in response to question 2 above, skills development requires a solid grounding in knowledge to be effective. Physics pupils not only need to know how to conduct experiments, but also why specific approaches and parameters are important to give the experiment value and provide reliable outcomes, what results signify (e.g. to allow for proper interpretation of data) and why they matter to understanding and applying knowledge. Some physics-based understanding is either too small to be practically observed in a classroom setting (e.g. the atomic and subatomic) or too large (often requiring large, very technical, and hugely expensive equipment (e.g. particle acceleration), or by definition deriving from external sources (e.g. astronomy)); and others (e.g. nuclear energy) which would be too complex or dangerous to witness in a school setting. Modern technology can help substantially with bringing these concepts to life for learners without having to visit such installations themselves – which again has cost and time implications.

The OECD review of the Curriculum for Excellence identified that the role of knowledge was not sufficiently clear or consistent, especially in the Broad General Education (BGE) phase. Skills assessment in the Senior Phase is more likely to be successful with a more knowledge-rich BGE curriculum.

Physics teachers have reported to us significant issues with practical assessments currently employed within subjects, in some instances deeming them not fit-for-purpose. We referred in our response at Phase 2 to the disadvantages of adopting a uniform approach to assessment and the

[4] SQA attainment statistics, 2022. 13,210 entrants took the subject at National 5, 8,045 at Higher, and 2,130 at Advanced Higher.

unhelpful overlap in practical assessments between different science subjects, and the effects they have on stress for learners and additional work for teachers.

It also does not seem clear from the interim report what approach will be taken to testing skills in action and what the basis of assessment will be. Candidates will not only want to know this but deserve to know to allow time to prepare. Care should be taken to ensure that assessment methods are suitable for those learners who experience neurodiversity issues.

4. What are your views on the proposals designed to recognise achievements in respect of personal learning?

It is worth reiterating the concerns we raised during phase 2 that recognition of external achievements may seem appealing, but raises substantial questions about practicality and bureaucracy for schools and teachers to manage if they are expected to validate and verify non-academic achievements, fairness in how different types of achievements are recognised and whether access to such opportunities are evenly spread (including, for example, among learners from deprived backgrounds or who live in rural communities, who experience neurodiversity issues, or for whom English is a second language). Formalising achievements in these areas might also enhance pressure to participate and perform in these settings in particular ways, and create expectations that learners who want to succeed should be engaging in these opportunities, which could also enhance stress for learners who are introverted or experience neurodiversity. It may also create a bias towards activities which more readily generate evidence of achievement (e.g. the badge structure of the uniformed organisations) rather than those which allow full exploration and expression of each individual's interests and talents.

The school system, rightly, invests effort and resources to try and maximise fairness between learners: this approach is often not practically possible, or possible to the same degree, through external organisations, nor is it reasonable to assume analogous levels of rigour about quality assessment (e.g. via the inspection framework). This creates a risk that recognising external achievement, in an effort to be inclusive, could enhance and formalise disadvantages and inequities.

5. What are your views on the idea of a Scottish Diploma of Achievement for all learners in Scotland?

There is nothing wrong in principle with a certificate of achievement, but the effect and practicality of this would substantially depend upon how it is derived and whether it works effectively for the purpose(s) it is to be used for.

In terms of how it is derived, it is not clear at this stage how two year courses might fit into a three year senior phase and how to combine certification at the end of schooling and at end of the study of a specific subject. It can be a motivating factor for pupils to see recognition of their progress in learning throughout education, and conversely it could be demotivating to have to face an assessment, or receive a qualification, significantly after a period of study has stopped. It is also reasonably commonplace for some pupils and their teachers to be risk-averse, and want to "bank"

achievement and recognition at certain levels of study before testing themselves at higher levels. The attrition rate of 39% between National 5 and Higher physics, and of 74% between Higher and Advanced Higher, seems to confirm this, and this trend is reflected in other subjects. For these reasons, a certification model based upon when a pupil stops studying a subject, rather than when they stop school altogether, would seem much more practical, however, runs the risk of allowing the maintenance of the current system due to societal pressures for candidates to only decide on further study once assessments at a lower level have been seen to have been attained.

It is not immediately clear how the proposed model would overcome the longstanding "two-term dash" issue as single-year courses will be needed to complement two-year courses within the current three-year Senior Phase. Whenever single-year courses occur this will promote a return to the "two-term dash" and as schools may not be able to resource parallel single-year and two-year courses: for reasons of cost-effectiveness and flexibility, the single-year options are likely to dominate. A more logical approach may have been to approach six years of secondary schooling in terms of three phases each of two years in length rather than the current three-year Senior Phase. This would complement the minimum school leaving age of 16, and create more opportunities for two-year post-16 education to take place in different settings with collaboration between schools, colleges, other training providers and with local employers helping promote parity of esteem between different routes for ages 16-18.

In terms of the purpose of assessment, qualifications operate not only as recognition of achievements in their own right, but also as convenient and accessible tools to determine routes towards positive destinations, including work, research and further study. There seems to be insufficient detail about the interface between the Senior Phase, and Advanced Higher in particular, with the standard four-year Scottish undergraduate degree structure and content. To allow maximum flexibility, any qualification or certification must also allow for the easiest translation into work and further study not only in Scotland but elsewhere. This is strongly true for physics and other STEM subjects, where knowledge and skills are not tied to geographical locations, and where there is a strong tradition of international collaboration and exchange. Some opportunities have already changed and been limited following Brexit (e.g. replacement of access to the Erasmus+ scheme with the Turing scheme), and uncertainty about the value of qualifications could add to this disruptive effect.

6. If you support the idea in question 5, what actions should be taken to make this approach work in practice? What alternative would you propose that would be consistent with the vision and principles identified in Phase One of the Review?

As noted in response to Question 5, a proposed Diploma of Achievement has the potential to be helpful, but a lot of details remain unclear which makes it difficult to reach an informed view. We do believe, however, that the system should allow for overall assessment of knowledge and progress rather than penalise and even disqualify based on discrete areas of difficulty. Some recent and current assessment arrangements can place a ceiling on an overall grade if a candidate receives a comparatively low mark in one area of knowledge, even if they obtain much higher

marks elsewhere within the same subject – this can be dispiriting as well as unfair, and may prompt an avoidable proportion of resit examinations, which seems a disproportionate solution to a minor issue. This risk could be elevated in a subject like physics where the curriculum has several quite distinct elements (so, for example, it is not always automatically the case that candidates who have a firm grasp of the principles of mechanics, light, electronic circuits and radioactivity will necessarily have the same grasp of relativity and quantum).

7. What changes to existing practice, if any, would you recommend to support the development of a new qualifications and assessment system?

We referred in our responses to Questions 2 and 3 above that the basis of scientific or STEM knowledge and learning is different from other fields of study and other subjects. This different knowledge base must be recognised to give learners a proper appreciation of the subject, and should also be reflected in the qualifications and assessment system. Previous reforms of Scottish education have sometimes sought to impose uniform approaches to assessment which do not suit all subjects equally well.

We referred in our response to Phase 2 to the "Researching Physics" unit of the Revised Higher physics course. This remains a good example of how flexible approaches to different subjects could work well, and it was regrettable and ironic that these approaches stopped when the Curriculum for Excellence was introduced and were replaced with formulaic assessment instruments that promoted 'hoop-jumping' and the rote learning and regurgitation of answers in assessments. It seems paradoxical that a curriculum which is designed to imbue a wide range of knowledge and skills for success in life should be attached to an assessment model which is homogenous. The most successful strategy for ensuring that these errors are not repeated would be to develop and test assessment models alongside learners and the teaching profession. A properly co-produced model would also increase the likelihood of buy-in and commitment across the system.

8. To promote parity of esteem across all qualifications, academic or technical and professional, should all qualifications at a particular SCQF level have the same name?

We can see certain advantages in consistency of naming qualifications, but we would not advocate for dispending with longstanding names which are well-recognised and respected, such as Highers, which can be traced directly back to the 1880s, and therefore have survived for around six generations. This is not to say that it has remained static, however, with the revisions of the 1990s allowing for both continuous assessment towards the final grade but also incorporating them within a national framework, the SCQF, to achieve a ladder of achievement. We have not seen any evidence that the name Higher causes confusion among pupils, parents and families, teachers, higher and further education institutions, or employers, but there is a risk that adopting a new name might do so.

9. Do you have any additional comments about the proposed approach to qualifications and assessment set out in this paper?

No

10. Given we are now in the final phase of the Review we would be interested to receive any feedback on our approach to this important exercise.

We welcome the extension to the consultation period for Phase 3, which we hope will allow more interested organisations and individuals who wish to engage with the process of education reform to do so. We note that there was also an extension during Phase 2: we hope this experience will prompt reflection by the review team and supporting officials on the timescales originally set out for the review to conduct its work.

The Scottish Government has undertaken an extensive programme of education reform which poses both fundamental and practical questions in a one of the most significant areas of devolved public policy and public service delivery, which affects the careers and life opportunities for almost all of Scotland's children and young people. It is essential that time and space be afforded to all of those organisations and individuals who have an interest in engaging with the issues and the process of education reform to do so, and also to allow time to reflect on the contributions received.

The comparatively short period (in public policy terms) between the closing date for submissions in Phase 2 and the publication of the interim report raised concerns about how practical it would be to digest and reflect appropriately on all 700 submissions received before issuing the review's interim report. We hope that the review team uses the remainder of its time to offer reassurance to those who have engaged that the process is genuinely reflective and that a wide variety of views and evidence are being considered before recommendations are finalised.

11. Please provide details of who has been involved in this response, for example are you a group or an individual.

In terms of the list provided, we would be classified as "Other" (i.e. a non-school/college organisation). However, we have substantial numbers of members who are physics teachers and our response reflects feedback we have received from them and others involved in physics learning and teaching.

The Institute of Physics is the learned society for physics and professional body for physicists across the UK and in Ireland. We seek to raise public awareness and understanding of physics, inspire people to develop their knowledge, understanding and enjoyment of physics and support the development of a diverse and inclusive physics community. Our mission as a charity is to ensure that physics delivers on its exceptional potential to benefit society.

About this response

We are content for this response to be published. If you wish to follow up the issues raised in it, please contact:

Stuart Farmer
Learning and Skills Manager
IOP Scotland

E-mail: stuart.farmer@iop.org

Submitted via email to qualificationsreform@gov.scot