International Advanced Level
Subject: Mathematics
The need for Transferable Skills

Sources: Cognitive/Intrapersonal and Interpersonal skills adapted and taken from the NRC framework

In recent years, higher education institutions and employers have consistently highlighted the need for students to develop a range of transferable skills to enable them to respond with confidence to the demands of undergraduate study and the world of work. The Organisation for Economic Co-operation and Development (OECD) defines skills, or competencies, as 'the bundle of knowledge, attributes and capacities that can be learned and that enable individuals to successfully and consistently perform an activity or task and can be built upon and extended through learning'.

To support the design of our qualifications, the Pearson Research Team selected and evaluated seven global 21st-century skills frameworks. Following on from this process, the team identified the National Research Council's (NRC) framework as the most evidence-based and robust skills framework, and have used this as a basis for our adapted skills framework.

The framework includes cognitive, intrapersonal skills and interpersonal skills. These skills have been interpreted to ensure they are appropriate for this subject. All of the skills listed are evident or accessible in the teaching, learning and/or assessment of the qualification.

Identifying and highlighting these skills in International Advanced Level qualifications ensures that it is not only the academic and cognitive skills that are developed, but those broader elements that universities highlight as being essential for success. Skills such as self-directed study, independent research, self-awareness of own strengths and weaknesses and time-management are skills that students cannot learn from a textbook but have to be developed through the teaching and learning experience that can be provided through an international curriculum.

In the tables below, we have taken the NRC framework skills and provided definitions of how each skill can be interpreted for this subject. This will enable teachers and learners to understand examples of how they can develop each skill through an International Advanced Level qualification.

Intrapersonal skills	
Intellectual Openness	
Adaptability	Respond to a new concept, idea, topic, model or scenario in an open and positive spirit, showing the ability to broaden conceptual horizons in interpreting and understanding the new material.
Personal and social responsibility	Use mathematics to undertake a specific task for which one is accountable or which develops social awareness in response to ideas. Use Mathematics to communicate social ideas and to analyse claims made by others.

Interpersonal skills	
Teamwork and collaboration	
Communication	Use mathematics as an effective medium of communication of ideas, concepts and solutions to problems. Use questioning skills appropriately to elicit further information or information needed.
Collaboration	Sharing work with others to break down a mathematical task, or separate cases, into more manageable pieces.

Cognitive skills	
Cognitive Processes and Strategies	
Critical thinking	Using many different pieces of mathematical information (sometimes seemingly unrelated) and synthesising this information to arrive at a solution to a mathematics-based problem. Evaluating the suitability and/or limitations of models used. Evaluating the reasonableness of information/data given and that found.
Problem solving	Assimilating information given, or data found, determining the goal and establishing at least one route from the one to the other. Combining information in what is often a multi-step process. Drawing diagrams and introducing helpful notation. Selecting the most efficient route to the solution from other possible routes. Checking that the answer is reasonable. Selecting and realising an elegant solution

Continuous Learning	Reflecting on ideas learnt, problems met, whether solved or not, and using these to improve on one's own performance in the future. Taking an active role in planning one's own learning. Setting goals and meeting them in a continually developing fashion. Understanding how ideas, such as rigorous logical thought, can be applied to future decision-making situations, used to assess the credibility of arguments and validate claims.
Intellectual interest and curiosity	Undertake a research or learning task which is self-directed. Pursuing a line of personal interest through appropriate research methods, including using information and computer technology and wider reading. Exploring further ideas met during the course of study. Seeing how mathematics can be applied to other fields of study.
Work ethic/conscientiousness	
Initiative	Showing a willingness to undertake self-motivated lines of enquiry and go beyond the given parameters. Study material prior to a lesson on that topic. Decide to challenge oneself by tackling more challenging problems on a topic.
Self-direction	Planning and carrying out tasks under one's own direction.

Teamwork	Working with other students to solve mathematical problems, explore strategies or pool ideas.
Co-operation	Sharing resources, ideas, strategies and results with other students.
Interpersonal skills	Use verbal and non-verbal communication skills in a discussion.
Empathy/perspective taking	Advocating the position of another in a discussion. Being sensitive to the feelings of others when correcting their mathematical work.
Negotiation	Attempting to reach shared conclusions with others, compromising, where appropriate by using negotiation skills.

Analysis	Analysing given information and data, determining if it is relevant of irrelevant to the solution of the problem. For the information/data that is relevant analysing its credibility and how it should be used in the solution of the problem. Using formal methods of mathematical analysis e.g. considering limits as variables tend to infinity or zero.
Reasoning/argumentation	Constructing a reasoned, logical argument and being able to defend it if necessary. Being able to deduce additional information from given information. Thinking logically and precisely and being able to prove, justify or argue that the approach taken is valid. Detecting any flaws, omissions or errors in reasoning.
Interpretation	Assimilating information given in a variety of ways, text, diagrams, charts, tables, graphs etc, and in a variety of forms. Being able to explain solutions and reasoning in a variety of ways, producing, as appropriate, their own text, diagrams, charts, table, graphs etc. Interpreting the precise meaning of technical terminology and its implications. Choosing to use, and using, technical terminology correctly in their own work.
Decision Making	Comparing possible solutions or routes to solutions and making a choice about their preferred route or solution. Using formal mathematical decision- making algorithms Evaluating the reasonableness of solutions or hypotheses and deciding if they should be accepted or not.
Adaptive learning	Responding to unfamiliar contexts and situations. Being able to adapt standard techniques to non-standard situations. Understanding when special situations may enable a more elegant or efficient solution. Checking that the solution is plausible. Determining how a model could be refined to make them more realistic.

Responsibility	Take responsibility for any errors or omissions in work and create a plan to improve.
Perseverance	Actively seek new ways to continue to improve own learning, despite setbacks, with willingness to re-try, start again, try a different approach, undertake further learning or keep at a task until completed.
Productivity	Working effectively and to a high standard in response to mathematical problems.
Self-regulation (metacognition, forethought, reflection)	Developing strategies over time, including self-assessment and critical review, for reflecting on the success or otherwise of the work.
Ethics	Producing output with a specific moral purpose or exploring the ethical intentions of a piece of mathematics. Use mathematics (such as logical reasoning, statistics etc.) as a tool to communicate, evaluate and debate ethical issues.
Integrity	Taking ownership for one's own work and willingly responding to questions and challenges; employing working methods which are honest and appropriate. Crediting other's input as appropriate.
Positive Core Self Evaluation	
Self-monitoring/self-evaluation/self-reinforcement	Developing the self-motivated habit of planning, completing and reviewing one's own work as a matter of habit, critically and constructively.

Leadership	
Leadership	Taking a leading part in a group task, assigning sub-tasks, considering representations and different viewpoints. Resolving conflict.
Responsibility	Taking responsibility for delivering, within agreed time constraints, one's own part within a group task.
Assertive communication	Directing work to a conclusion and addressing conflicting viewpoints. Using persuasive techniques effectively to convince of a point of view.
Self-presentation	Presenting a topic, idea or solution to the class.

Executive function	Carrying out successfully a planned approach to the solution of a problem. Understanding the situation, planning a route through the problem and following it accurately to find the solution. Reviewing the solution to see if the solution is plausible and to see if there is a more efficient route.
Creativity	
Creativity	Creating problem solving routes through unfamiliar problems. Showing insight in dealing with unfamiliar situations, contexts or problems. Producing elegant, efficient methods of solution, or in presenting a solution or display of data
Innovation	Using insight to find the links between two situations or topics. Exploiting these links to use, or adapt, techniques, methods, strategies learnt in one situation to the other, seeing isomorphisms. Understanding when the situations are so different that this is not possible.