

Developing Good Team-working Skills in Primary Schools

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Introduction

Many of the resources on NRICH are built around, or at the very least offer opportunities for, group work. In particular, all the problems published on the NRICH website in May 2010 have "Complex Instruction and Group-worthy tasks" as their theme, and they can all be found by clicking on Past Issues.

Teachers often remark on how difficult it can be to get learners to work on some mathematics as a team. My response is generally that learners cannot suddenly be expected to work in ways that include listening and responding to the needs of others, sharing ideas and working collaboratively if they have not had sufficient experience of activities that encourage such behaviours. These skills need to be developed over time and so learners need lots of practice.

One way to improve learners' team-working skills is to work in ways that encourage collaboration and sharing mathematical journeys in smaller and larger groups on a regular basis. To develop such an approach it makes sense to use the experiences of others and build on practices that have worked in other situations. Of course there is no perfect answer but using methodologies that have been researched and have some rigour behind them can save a lot of time and reduce the risk. Such research on group working is discussed by Elizabeth Cohen in her book "Designing Groupwork" and utilised by colleagues currently working with Jo Boaler in the UK on Complex Instruction. There are many of what Jo Boaler might describe as 'group-worthy tasks' on the NRICH site. In fact it is hard to find a list of problems that you would not describe as group-worthy if used in a particular way in the classroom.

Many schools who utilise the benefits of group work start by spending a significant amount of curriculum time using activities that offer opportunities to develop team-working skills, knowing that this will pay dividends in the long term. Such tasks are sometimes called skill-building tasks. The skills are group-working skills rather than mathematical skills. This article and the linked resources take this idea and offer some skill-building tasks built around mathematical knowledge. The aim is to make the time spent on them feel less like risk taking because learners will be doing mathematics as they build skills of collaboration. In her book, Elizabeth Cohen lists a set of skills related to working collaboratively which the following is based upon:

- Listening
- Asking questions - making sense of your own understanding
- Explaining by telling how and why
- Helping others - by responding to their needs
- Helping others - to do things for themselves
- Sharing knowledge and reasoning
- Finding out what others think - asking for, listening to and making sense of their ideas

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- Reflecting on and making use of what has been said
- Being concise - communicating thinking
- Giving reasons for ideas - communicating reasoning
- Allowing everyone to contribute
- Pulling ideas together - sharing, listening, valuing all contributions
- Finding out if the group is ready to make a decision - consensus making.

Developing skills and norms

These collaborative working skills can be developed through particular group activities. Below we offer six categories of **team-building** activities that can be used to place the learner's focus on a range of the different skills. Underpinning the tasks are some fundamental principles of developing interdependence and developing group and individual accountability.

Interdependence comes in two forms:

- Goal interdependence - occurs when each group member can only achieve their goal when other group members have achieved theirs - for example "In the Middle" and "All for One" tasks below are designed to develop this principle.
- Resource interdependence - when each group member needs resources or information from other group members to complete their task - for example "Who Needs?" and "Telling How" below.

Group accountability can be associated with all the task types but "Guess the rule" and "What am I?" have a particular focus on this aspect of accountability.

Each category of **team-building** task has particular rules associated with it. These rules are designed to draw out particular team-working skills. **It is therefore very important to allow time at the end of each activity for discussing the task and the way teams and individuals worked together.** If available an observer may be used to focus attention on, and note, particular activities and behaviours.

The Six Categories and Example Problems

1. Who needs?

These tasks are only successfully completed when everyone on the team has completed their part. They depend upon members of the group noticing the needs of others and responding. The tasks are generally completed in silence. They require learners to:

- respond to needs of others
- help others to do things for themselves.

Examples from NRICH in order of level of mathematical challenge:

[Number Match](#) Stage:1 and 2

[Fraction Match](#) Stage:2 and 3

[Quad Match](#) Stage: 2

[Doughnut Percents](#) Stage:2 and 3

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Making Rectangles Stage:2 and 3

The list could go on for ever, but it is also worth mentioning using any set of objects or images for this sort of task. For example:

Sets of Dienes' Logiblocs. Ask teams to collect sets based on similar properties. Part of the task could be that the team discusses whether the sets are logically connected - all triangles here - all squares there, or all thick shapes here ... etc;

Compare bears;

Sets of mathematical solids, or counters (each player ends up with one of every colour or all the same colour or ...)

2. In the middle - Pulling ideas together to produce a single product

A designer makes an arrangement of objects without the team seeing it. The team has to recreate the arrangement by asking questions. These tasks depend on groups working collaboratively, discussing and reasoning to agree a final product in the minimum number of questions. These tasks require learners to:

- listen and find out what others think
- give reasons for ideas
- pull ideas together
- find out if the group is ready to make a decision.

Examples from NRICH in order of level of challenge:

Note that these examples can be easily changed to make them harder or easier.

Counters in the Middle Stage:2

Castles in the Middle Stage:2 and 3

You can create similar problems using any set of materials such as:

3D solids (build a church with a spire and see if the team can recreate it!),

sets of polygons (create regular or semi-regular tessellations).

3. Explaining how - Giving and following instructions to produce individual products

A designer gives instructions to members of the team so that they can create a mathematical object or picture identical to that made by the designer. No one on the team can see anyone else's work. Tasks in this category require learners to explain and help others, asking and answering questions. Learners must complete the task themselves but with support and advice which is asked for and given. They encourage learners to:

- help others to do things for themselves
- respond to the needs of others - everybody helps everybody
- explain by telling how.

Examples from NRICH in order of level of challenge:

En-counters Stage:1 and 2

Stick Images Stage:2 and 3

Coordinate Patterns Stage: 3

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Similar tasks might involve:

creating a 3-D image made of cubes or solids,

creating a mathematical construction using a ruler and pair of compasses (for example a petal pattern or constructing an equilateral triangle or hexagon),

making a tessellation.

4. Guess the rule - Collaboration and reasoning to come to a shared decision.

These tasks depend on learners sharing reasoning, listening to opinions, reflecting and pulling ideas together. The team guesses the rule in the minimum number of questions. These tasks require learners to:

- find out what others think
- give reasons for ideas
- be concise
- reflect on what has been said
- allow everyone to contribute.

Examples from NRICH in order of level of challenge:

[Guess the Houses](#) Stage:1

[Guess the Dominoes](#) Stage:1 and 2 and 3

Similar tasks can be created using:

number cards. Rules might include: only even numbers, only square numbers etc.

Dienes' Logiblocs with rules including: all red, all triangles, all thin shapes etc.

5. What am I? - Asking and answering questions to draw conclusions

Tasks which develop the communication of reasoning. By framing and asking questions a member of the team has to find out what mathematical object they have chosen. These tasks require learners to:

- ask questions - making sense of their own understanding
- be concise
- listen
- reflect on what has been said.

Examples from NRICH in order of level of challenge:

[What Shape?](#) Stage:2 and 3

[Which Solid?](#) Stage:2 and 3

What about:

Which number?

Which statistical diagram?

Which Dienes' Logibloc?

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6. All for one - Collaboration towards a single goal

Tasks which develop the skills of sharing reasoning and agreeing, through the production of a single product. These tasks require learners to:

- allow everyone to contribute
- listen
- ask questions and find out what others think
- share knowledge and reasoning
- reflect, and make use of, what has been said
- come to a consensus.

Examples from NRICH in order of level of challenge:

[Arranging Cubes](#) Stage: 1 and 2

[Arranging Counters](#) Stage:2

Simpler, or more complex versions, of each of these tasks can be produced. For example: A series of beads threaded on a string can be generated by learners sharing the images on their cards, or a line of Compare Bears.

Some final advice

As these skills are developed, learners will also develop team norms, that is the set of rules or guidelines that shape the way they work with each other. Once developed, team norms are used to guide team member behaviour. Team norms are used to assess how well team members are interacting. Team norms enable team members to challenge "non-norm" behaviour. For example, challenging another member of the team who is not listening to the ideas of others.

References

Cohen, E. G. (1994) *Designing Groupwork - Strategies for the Heterogeneous Classroom*. Second Edition, Teachers College Press.

You can find a collection of short articles that outline the merits of collaborative work, together with examples of teachers' classroom practice at <http://nrich.maths.org/7011>