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Developing a more holistic approach to teaching, learning and assessment

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Developing a more holistic approach to teaching, learning and assessment

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Abstract
Stories in this research study were used to provide authentic design and technology contexts for Key Stage 2 (11 year old pupils) and Key Stage 3 (13 year old pupils), in two different schools. Both learning contexts involved the pupils in problem solving and creative working in groups, two key skills of business and commerce. Dilemma, mystery and intrigue within the different stories invited the pupils to think, act, and reflect on a number of open-ended issues, some of which had no immediate or obvious answers. Classrooms for the 21st Century, it is argued (Marton et al., 1993; Wallace, 1996; Watkins, 2001), need to provide contexts for learning that will encourage children to think logically, critically and creatively, to reason and reflect, and be less dependent on their teachers. These qualities are essential if pupils are to be equipped with the learning dispositions and capability needed to manage complexity and uncertainty, and engage in futures yet to be envisaged. Both stories were used to stimulate and initiate purposeful Design and Technology activity that challenged pupils to think and act, individually and collectively. The stories provided new environments for pupils to think in and be creative, and helped place concepts in real and meaningful contexts (Vygotsky, 1987).

In this more applied research study, the class teacher and researcher sought ways of integrating the development of positive learning dispositions with classroom pedagogy. The research hypothesis, that engagement with authentic and creative activity developed positive learning dispositions as well as technology capability, was tested. A framework of learning dispositions, organized into four domains, (EPIC): Expressive, Productive, Innovative, and Collaborative, attempted to provide a more holistic view of learning in the classroom. The framework facilitated more informed teacher observations and reflection on the learning process. It also formed the basis of a more divergent form of assessment and proved helpful in monitoring pupil engagement with authentic tasks. Five levels of engagement were identified: Level 1 indicated a reluctance to engage naturally with a task, with no evidence of exploratory or creative activity, while Level 5, recognised engagement as continuous, open-ended, reasoned and highly creative.

Data was generated using audio and video recording of pupil and teacher interaction and by keeping research diaries and examples of pupil work. The work is still at an embryonic stage but it has been successful in challenging teachers' views and conceptions of learning. The study has encouraged reflection on teaching and assessment practices at a much deeper and analytical level.

Keywords: *interaction, active engagement, authentic, learning narrative, feedback, formative assessment*

Rationale
Design and technology has the potential for engaging pupils in problematic and challenging learning situations. Such situations demand strategic reasoning, insightfulness, perseverance, creativity, and precision for their resolution. In the process of developing technology capability, pupils at the same time are accessing, utilising and strengthening those same learning dispositions considered essential to meet the complex demands of the 21st Century.

Process ***IS*** content, and dialogue, interaction and a creative spirit of enquiry need to be at the heart of that process. Thinking skills need to infuse subject content (Costa, 2003; Mc Guinness, 1999) and more divergent and holistic forms of assessment need to be developed (Torrance & Pryor, 1998). '.... Inquiry, exploration, individual interpretation and response, will always take precedence over the teaching of any factual content (Kimbell, 1982). Good thinking, thinking well, or thinking smarter is now a main aim of education. Our purpose must be to provide authentic learning contexts that will engage pupils in thinking for themselves and accepting responsibility for their own learning.

A framework of sixteen learning dispositions, organized into four domains of creative activity: Expressive, Productive, Innovative and Collaborative (EPIC) was designed. This framework was used as a basis for teacher reflection at a deep and analytical level. It was also useful in determining levels of pupil engagement with authentic tasks. The EPIC classification system operated on the premise that it was the activity of constructing knowledge



and understanding that became stored in the memory, rather than individual bits of knowledge and information. In that sense, making meaning, applying understanding, and reflective inquiry, was at the heart of the learning process. The teaching challenge became one of facilitating and supporting the development of positive dispositions to learning through authentic and creative classroom activity.

Research methodology
The research study had two distinct phases, March 2002 – Dec. 2002, and March 2003 – Nov. 2003. Data was gathered by the researcher using audio and video recording of class and group interactions and by keeping research diaries and examples of pupil work. The recording of classroom practice in Phase 1 provided the two classroom teachers with a valuable resource for review and reflection. Phase 2 was designed to build on this reflective experience, particularly with regard to classroom assessment and pupil feedback.

In the second year of the project, assessment and feedback were better integrated into the process of learning (Dweck, 1986). A main aim was to facilitate development of positive learning dispositions and technology capability through purposeful and authentic problem solving activity. The APU (1991) claimed that Design and Technology uniquely promotes development of this combination of personal, intellectual, social and physical capabilities. 'This is its education raison d'être, and in the schools context we must see the outcome of the activity, not as a three-dimensional artifact but as enriched and rounded young people' A main aim of the teacher, therefore, is to maximize the potential of the individual, by building on the natural curiosity, playfulness and resilience of the child.

In this more collaborative context envisaged for Design and Technology, forms of language arose that departed from the usual patterns of classroom discourse (Extracts 1-3). Feedback from the teachers focused on helping learners see and understand what could be done next, or differently. There was a greater emphasis on collaborative learning and exploring alternative methods of solving a problem. The classroom climate (Csikszentmihalyi, 1990), was one that supported challenge and problem solving by allowing pupils to be unsure, tentative, doubt, question, make mistakes and change their minds. There was greater fluidity in the teacher's role as teachers moved from a teacher fronted, transmission role, to one of transaction and partnership (Watkins, 2001). The view of assessment was becoming more divergent in practice and was being seen as more of a joint accomplishment by the teacher and pupil.

Domains of Learning Dispositions
The **EPIC** classification system (Appendix 1) shows the kind of dispositions considered necessary for developing pupil autonomy and capability (Costa, 2003). It also mirrors the creative process and the need for encouraging greater diversity in pupil learning. Through involvement in purposeful Design and Technology activity pupils were encouraged to accept responsibility for their learning and show initiative: be creative and expressive, productive, innovative and collaborative.

Since pupil interaction and engagement are the most visible manifestation of learning processes at work, it was decided to explore the use of EPIC as an indicator of pupil engagement with authentic tasks. '.... our knowing is in our action', Schfin (1983). Analysis of the video recordings showed some pupils engaging naturally and creatively with the problem solving activity whilst others showed greater reluctance and hesitancy. A minority of pupils was seen to practice avoidance tactics and a significant majority required teacher support and guidance. Well motivated pupils appeared to invest high levels of task related effort in pursuit of an appropriate solution. From analysis, five levels of pupil engagement with Design and Technology activity were identified and defined. EPIC was remodeled to provide a framework for action and reflection in the classroom in ways that supported effective learning.

Creating Interactive learning environments
The purpose of the design and technology activities was made clear at the outset, and the criteria for success were shared with the pupils from the beginning. The challenge in the classroom was to provide a learning environment and climate for learning that would encourage pupils to inquire, collaborate, share ideas, consider alternatives, and reach conclusions. It was considered important that pupils be given opportunities to reflect on the experience and learn from it so that they could apply and use it in future learning. Research indicates that active and reflective engagement in the problem solving process is essential for learning and significantly influences the quality of learning outcome (Bentley, 1998; Steinberg, 1998; Bayliss, 1999; Claxton, 2000).

Reflecting on their own practice after watching



video clips of Phase 1, teachers were surprised at the number of times they closed down opportunities for exploring pupil understanding rather than opening them up. Their focus on the 'product' tended to deny particular pupils real opportunities to be creative and adventurous in their thinking. Insufficient time was given for pupils to consider alternatives, to explore other possibilities, and to reflect and review their learning. Observation of classroom practice allowed teachers the opportunity to reflect on their teaching and question assessment practices.

In a number of instances, transcripts were made of the dialogue and interaction in the classroom. From these, effective teaching and learning would seem to necessitate:

- making the learning situation problematic and making learning happen through active engagement with problematic situations;
- developing learner partnerships in the classroom and a more flexible role for the teacher in using language to support and scaffold learning;
- providing greater diversification of teacher audiences beyond that of expert-examiner;
- valuing a commitment to collaborative and cooperative learning;
- promoting a learning orientation with pupils by encouraging a positive relationship between effort and ability;
- developing a more divergent form of assessment and one where assessment and feedback are integrated into the process of learning;
- developing those positive dispositions and attitudes to learning that place pupils more in control of their own learning;
- encouraging sensitivity in managing turn taking and social interaction.

The following three extracts highlight the kind of 'responsive understanding' and 'interaction' that Phase 2 was designed to promote in the classroom. Deepened teacher reflection in each case shows the potential for integrating assessment and feedback into the process of learning.

Extract 1
Problem with Lateral movement (Story: The Day the Monster Came)

T You are having difficulty with this Matthew.... What do you think is the problem?

M Keeps moving from side to side (pointing to the swinging mechanism of the card beam)

T Why do you think it's doing that? .... Look at it carefully and tell me why...

M When I press here (at the counterweight end).... it just does it...

T But why does it do that? ... are you using too much force? .... have you tried a smaller force?

M ... Still does it (Matthew knows what the word force means and experiments with different finger pressures to see if it makes a difference..) .... I've already tried that .... doesn't work....

T Well we now know it's not the size of the force that is causing the problem .... Can you suggest anything else we could try? ..... (pause)..... how about looking at the pivot ... how did you make the pivot?

M Put the rod through it (metal rod inserted as a pivot through hole in card beam)

T Would you say the pivot is a tight fit Matthew?.... look at it as you move the counterweight end....

M It wobbles ....

T That's a good word Matthew, can you discover what is causing it to wobble?

Matthew went on to glue a piece of card over the hole that he had made and then reinserted the pivot rod. This did not work to his pleasing but after some perseverance and struggle he glued a part lollipop stick to each side of the beam and this worked when he inserted the pivot. Matthew was really pleased he had solved the problem and with teacher support, he had remained *open-minded* and *persistent* until he was happy with the outcome.



Teacher reflection
Matthew was able to solve this challenging problem with teacher guidance and support. As a result he appeared less impulsive and better focused in his problem solving behaviour. Matthew needed to accept that it was OK to be stuck but needed help and support in working out what was causing him to be stuck and how he could become unstuck (Based on Teacher Observation 1, Appendix 2).

Pupil reflection
It is OK to be stuck with a problem but then you have to become unstuck. Think about:

- *ask yourself **why** you are stuck... make a note of these questions*
- *work out a procedure for tackling these questions;*
- *stick to your plan and only change it when you have a better one;*
- *keep at the task knowing a solution is possible.*
- *Don't give up, it will take several attempts before you find a solution you are happy with.*

Extract 2
Vanessa's invention
In this extract, Vanessa, with guidance from the teacher, designed a clever solution to the balancing problem. In the process she showed imagination, resilience and resourcefulness. Vanessa owned the problem and remained in control of it. Initially she was puzzled by the balancing mechanism. She understood how the 'nodding dog' mechanism worked, but transferring that concept to the monster design was a real challenge. Vanessa's learning story was as follows:

V .... It needs suspending (referring to the card beam used as the balancing mechanism) ... not too sure .... need to think about it .... (plays about with a short length of wire rod which others had used for making a pivot...)

(picks up the dog and uses it as a reference) ... uses wee hooks (explains to the teacher how the wire hooks connect to make the head nod .... picks up the wire rod again and attempts to push it rather clumsily through the sides of the card prism/body shape)

T What are you trying to do with the rod Vanessa?

V Trying to push it through the sides (of the body)... (Vanessa struggles to insert the soft wire rod through the card body) .... I want to hang the beam (swinging mechanism) from the wire (Vanessa has worked out an excellent way of solving the problem and now has a picture in her mind's eye of how it would work)

T That's clever Vanessa.... That's an excellent way of solving the problem ... Think about the wire for a minute.... Do you need to push it through the sides to do that? .... there must be an easier way of using the wire (teacher knows what Vanessa is trying to do and is encouraging her to look at other ways of using the wire rod)...

V I'm thinking about it.... (removes the wire and studies the problem... in an exploratory way she rests the wire on top of the card body and looks at it....) ... I know.... I could use the wire like a bridge across the top (of the prism/body) .... (quickly she decides) .... a better way would be to bend the wire down at the ends..... keep it from moving... that would work (Vanessa is now in the process of improving her original idea to make it work even better....)

T An excellent invention Vanessa .... How could you keep the wire in place?

V I could use Sellotape.

T That would work... are there any other ways of holding the wire in place?

V (Studies the problem and goes off to get scissors and sellotape.... working independently, Vanessa went on to cut two short slots in opposite sides of the prism for the wire rod to drop down into. She had also flexed the sides of the body slightly so that the U-shaped wire rod fitted in tightly and remained in place....)

T Brilliant Vanessa... that is really clever .... Really impressed... (T asks V to demonstrate to the class how her invention was going to work .... The next challenge was to suspend the card beam inside the prism/body from the overhead wire)

How are you going to suspend the beam form the wire Vanessa?

V I could use thread ..... let it swing (pointing to the card body with confidence...)

T Very good.... You are winning Vanessa ... that's a really good invention... it will work well.



Teacher reflection
Vanessa had developed a clever solution to the counterbalance problem. She showed commendable resilience and imagination in the process. Her solution was not automatic but she did respond positively to the verbal prompting needed to make the connections. There was a clever moment of insight when the door to the solution was jointly opened and Vanessa went through to complete the task most effectively (Based on Teacher Observation2, Appendix 2)

Pupil reflection
Well done Vanessa, you have invented a clever method of solving this challenging problem. Some things to think about:

- *Write down what you think was important in helping you solve the problem.*
- *How did you feel as you worked your way through the task? Were you always confident that you would solve it?*
- *What have you learnt that would be useful to you in solving other practical problems?*
- *Do you think it would be possible to make a sketch of the mechanism to show how it works? You could try putting your drawing inside a crate. That would be really good.*
- *Use your sketch to explain to others how it works....*

Extract 3
Katie asks a challenging question (Story: Ted's Dilemma)
In this problematic situation, pupils were experimenting with the strength of manila card for use in the bridge project. Prior to this they had watched a PowerPoint presentation that showed different types of bridges and cantilever cranes. Having designed the tower for their bridge, pupils had to design a rise and fall drawbridge mechanism to allow the boats to pass underneath. This provoked Katie to ask a challenging question: Does the counterweight go to the top or bottom of the tower? This was a question that delighted, but also took the teacher by surprise. The question had not been anticipated and an immediate answer was not forthcoming. What resulted was an interesting dialogue and experimental session, first in groups, and then as a whole class. A part transcript of one of the groups shows the quality of thinking and interaction this question provoked.

P1 I think it should go to the top ... keeps it (tower) from falling over...

P2 I agree with (P1) because it needs to be there when we put the drawbridge on... so it doesn't topple over.... (experimental session follows and the counterweight is glued to the upper side of the tower .... P2 tries to topple the tower with others looking on.... One of the pupils (P3) reaches forward and inverts the tower so that the counterweight is now at the bottom...

P3 I think it goes to the bottom .... it is better at the bottom (experiments trying to topple the tower)

P4 When we did science we looked at things with wide bases .... I agree with P3... it should be at the bottom

P2 But what about the drawbridge?... where is that going?.... I think it (counterweight) should still be at the top ....

P1 I said it should go to the top and now I think it should go to the bottom.... Does it matter if it is at the top or bottom?

P2 .... The cranes (referring to the photos) had the counterweight top and bottom .... that's the way they were ....

P3 Yeah... but, look at the photo... that one (pointing to the counterweight to the top) has the counterweight at the far end... (meaning that it was acting as a cantilever... an excellent observation which was critical to the dialogue) ...

P4 I agree with P3 and think it should be at the bottom.... because, it (the counterweight) has to be attached to the tower (not being used as a cantilever like the crane .... P3 experiments with the tower to make her point)

P1 (Picks up the tower and experiments with it in both positions) .... I think it works both ways.... Like the cranes... can be either way

P3 (Picks up the tower and gently tries to topple it by pivoting it along its bottom edge) .... I think it should be at the bottom .... You know why? .... If we're not allowed to glue the tower to a baseboard, then it's better at the bottom... (uses the tower to demonstrate what she means).

P1 Yes, I'm changing my mind... better at the bottom .... When the drawbridge is attached, the tower would fall over if the counterweight was stuck to the top (face).



A general consensus that the counterweight should be placed to the bottom of the tower was reported back to the whole class. After some wider class discussion, the group went on to design and make the drawbridge and winding mechanisms for their bridges. *Dialogue, interaction* and a *creative spirit of inquiry* was enhanced by the openness and responsiveness of the teacher to Katie's question.

Teacher reflection
Katie was well motivated by this challenge and could be seen exploring different solution possibilities. The position of the counterbalance had become a puzzle and her curiosity had been fired by it. Katie persevered with the task and collaborated with others in the group in arriving at a consensus view. Katie showed that she had been actively thinking about the task and was looking for a well reasoned answer (Based on Teacher Observation 3, Appendix 2).

Pupil reflection
An excellent question Katie and one that made the whole class think. Think about:

- *What helped you most to remain on task?*
- *Did you have to make changes to your action plan? Write down some important changes you made.*
- *Did you feel comfortable or uneasy making changes to your plan? How well did you cope with this?*
- *What other questions did you need to ask to complete the task?*
- *Which was your best question and why?*

Conclusion and ways forward
In this study, pupils engaged in authentic design and technology activity in ways that developed positive learning dispositions and enhanced technology capability. The approach was instrumental in challenging teacher views and beliefs on teaching, learning and assessment. In Phase 1, teachers seemed more concerned with 'delivering instruction' and 'covering the curriculum' as prescribed, rather than advocating and pursuing a particular view of learning. The teachers were quick to associate the concept of interactive teaching with 'good teaching' rather than with a particular view of learning. In common with the findings of Bliss, Askew and Macrae (1996), opportunities for 'scaffolding' pupil thinking and learning went unnoticed.

The use of video stimulated reflective dialogue at the end of Phase1, however, provided a significant opportunity for teachers to reflect on the potential of assessment and feedback to support learning.

> I am more aware of how pupils are going about their problem solving .... more keen to ask those kind of questions that tend to challenge their thinking and make them puzzle it out for themselves .... In the past I would have been happy for the pupils just to make something, but now I would make time for pupils to explain and talk it through.... **T1**

> It makes you observe pupils working in a group much more closely..... Sometimes it is nothing to do with lack of ability and more to do with pupils managing their distractions and being resilient..... Pupils need to be taught how to do this.... Taught how to handle distractions and be resilient.... I need to observe and talk more to pupils about their work and just what it is they are having difficulty with... **T2**

In Phase 2, the role of the teacher was becoming more fluid and teachers were recognizing the need to provide a range of teacher audiences in the classroom (Barnes, 1992; Corden, 2001). This was essential for promoting and sustaining the dialogue and interaction in each of the three extracts considered. Reflecting on the 'big picture', teachers were becoming more sensitive to the need for observing both process and product in the classroom, and adopting more divergent and holistic approaches to assessment. Such practices were serving the twin purposes of enhancing teaching effectiveness while improving pupil understanding. Teachers were beginning to adopt a more student-centred/learning orientated rather than teacher-centred/content-orientated, conception of teaching (Kember, 1997). Such an approach to learning encourages pupil confidence in dealing with complexity, the kind of learning young people need to be capable and competent in the twenty-first century.

With the emphasis on dialogue, contingent interaction and authenticity in the classroom, language was used as a tool for thinking, and social interaction acted as a tool for learning (Lyle, 1993). EPIC provided teachers with opportunities for developing more divergent and holistic forms of assessment in the classroom. Reflection in action generated valuable feedback for both teacher and pupil. Learning maps, showing levels of pupil engagement, with and without the help of a more knowledgeable partner, were constructed (Appendix 3).



A better way of mapping learning engagement may be to show the directional shift for each learner, either left or right, from a common centre line. As part of a new Comenius 2.1 project, EPIC is currently being trialed in a number of classrooms with pupils from different countries and different cultures. Its design and use is proving to be an important tool in teacher development, providing a more holistic view of teaching, learning and assessment.

References

Barnes, D. (1992), The Role of Talk in Learning, in K. Norman (ed.) *Thinking Voices: the work of the National Oracy Project*. London: Hodder & Stoughton.

Bayliss, V. (1999), *Opening minds: Education for the 21st Century*, London: RSA.

Beck, U. (1992), *Risk society* (trans. M. Ritter). London: Sage.

Bentley, T. (1998), *Learning beyond the classroom*, London: Routledge.

Bliss, J., Askew, M. and Macrae, S. (1996), 'Effective teaching and learning: scaffolding revisited', *Oxford Review of Education*, 22, 167-86.

Clarke, S. (2001) *Unlocking Formative Assessment*, London: Hodder & Stoughton.

Claxton, G., (1999), *Wise Up*, London: Bloomsbury.

Corden, R. (2001) Developing Exploratory Language in the Classroom: moving beyond teacher as expert, *Educational Action Research*, 9 (3), 371-393.

Costa, A. L., (2002), 'Changing curriculum means changing your mind'. Paper presented at the Tenth International Conference on Thinking, Harrogate, England.

Csikszentmihalyi, M. (1990), *Flow: The psychology of optimal experience*, New York: Harper & Row

Dewey, J. (1938), *Experience and Education*, New York: Macmillan.

DIAL:Connect Comenius 2.1 Project (2004-2007), 118155-CP-1-2004-1-UK-COMENIUS C21.

Dweck, C.S. (1986), 'Motivational practices affecting learning', *American Psychologist*, 41 (10): 1040-8.

Hamilton, J.W., (2003), 'Interaction, Dialogue and a creative spirit of inquiry', in Norman, E. & Spendlove, D. (eds) *Design Matters: DATA International Research Conference* 2003:35-44, Wellesbourne: DATA.

Kember, D. (1997), 'A reconceptualisation of the research into university academics' conceptions of teaching', *Learning and Instruction*, 7, 255-75.

Kimbell, R. (1982), *Design Education: The foundation years*, London: Routledge & Kegan Paul.

LaTech Comenius 2.1 Project (2001 – 2004), '94111-CP-1-2001-1-UK-COMENIUS-C21' Website: http://telematics.ex.ac.uk/latech/

Lave, J. (1988), *Cognition in Practice: Mind, Mathematics and Culture in Everyday Life*, Cambridge: Cambridge University Press.

Lave, J. and Wenger, E. (1991), *Situated learning*, Cambridge: Cambridge University Press.

Lyle, S. (1993) 'An investigation in which children talk themselves into meaning.' *Language and Education*, 7(3): 181-96.

Marton, F., Dall'Allba, G. and Beaty, E. (1993) 'Conceptions of learning', *International Journal of Educational Research*, 19 (3): 277-300.

McGuiness, C. (1999), *From Thinking Skills to Thinking Classrooms*. London: DfEE.

Mercer, N. (2000), *Words and Minds; How we use language to think together*, London: Routledge.

Rudduck, J. (1991a), *Innovation and Change*, Milton Keynes: Open University Press.

Schön, D. (1983), *The reflective practitioner*. London: Temple Smith.

Steinberg, A. (1998), *Real learning, real work*, London: Routledge.

Torrance, H. & Pryor, J. (1998), *Investigating Formative Assessment: teaching, learning and assessment in the classroom* (Philidelphia, PA Open University Press).

Vygotsky, L. (1987), Thinking and speech. In Rieber, R. W & Carton A.S (Eds) (1987). *The collected works of L.S Vygotsky*, New York: Plenum Press.



Wallace, G., (1996), 'Engaging with Learning'. In J. Rudduck, R. Chaplain and G. Wallace (eds), *School Improvement: What can pupils tell us?* London: David Fulton.

Watkins, C., (2001), *Learning about Learning Enhances Performance*. National School Improvement Network Research Matters No 13. London: University of London, Institute of Education.

Appendices

Appendix 1
EPIC Domains of Learning Dispositions

Expressive

- Confidence: expressing an idea (verbally, graphically, numerically, ICT....), thinking and communicating with clarity, accuracy and precision.
- Being curious: interested, expressing curiosity or the desire to know more: questioning and problem posing; inquisitive and enquiring.
- Open-mindedness: speculating, predicting, thinking aloud, remaining alert to situations, being hypothetical ...
- Responsiveness: responding with wonderment and awe, fun and enjoyment, sensitivity.

Productive

- Exploratory: investigating, experimenting, and gathering data using all the senses; innovative and persistent, open-minded.
- Strategic: planning, setting goals, planning procedures, prioritizing, organising and ordering events during problem solving.
- Applying: using what is known and using what is known to determine what needs to be known: making sense of learning situations.
- Monitoring: checking progress and thinking about thinking, reflective action.

Innovative

- Adventurous: handling uncertainty, taking responsible risks, having a sense of adventure, trying out new ways of doing things.
- Flexibility: thinking flexibly, suggesting alternatives, considering options, seeing things in different ways.
- Being creative: creating, generating, imaginative and inventive, being resourceful.
- Evaluating: evaluating a method or outcome, suggesting modifications, or improvements; looking for a better or more effective way ...

Collaborative

- Interdependence: interacting and thinking interdependently, working together, building trust, managing impulsivity, accepting responsibility.
- Resilience: persistence in negotiating ideas and reaching conclusions.
- Sensitivity: listening with understanding and empathy, suspending judgement.
- Coaching: scaffolding, supporting and encouraging, assisting and guiding.



Appendix 2
Teacher Observation 1
From observation, **Matthew** seemed to have come to a standstill in his thinking about the balancing problem. The mechanism was not working the way he had intended and he was appearing increasingly frustrated with this. The teacher at that point encouraged him to demonstrate and explain what he thought was causing the problem. Building upon this shared understanding of the situation, the teacher assisted and guided Mathew in his thinking, through careful probing and sensitive questioning. Problem solving dialogue and interaction with the teacher seemed essential for Matthew to remain on task and connect responsibly with it. It appeared that Matthew was capable of solving the problem once his attention was alerted to certain key features of the problem situation. This seemed to give him the self confidence to model and investigate other ways of solving the problem. The scaffolded intervention of the teacher was necessary for Matthew to better understand the problem and clarify his own thinking. Matthew appeared pleased that he had persevered with the counterbalance challenge and that his curiosity in solving it had been rewarded.

Teacher Observation 2
Vanessa appeared well motivated with this challenge and actively engaged with the different problems she experienced in solving it. She had worked out a good action plan and this seemed to give her a certain confidence in tackling it. The balancing problem was not straightforward and was causing her to think and rethink her method of solution. She appeared to approach the task in an organized way and seemed to have a number of lines of inquiry. At different times she went over and studied the nodding dog mechanism and then came back to work quietly on her own. She had worked out that she could suspend the balancing mechanism from the wire rod but the way she was doing it was proving difficult. When teacher asked her to explain what she was doing it seemed to provide a welcome moment for reflection. In response to the teacher's question about her use of the wire rod, Vanessa appeared to intuitively come up with the idea of using it as a bridge. This moment of insight proved to be the trigger for what turned out to be a clever solution. Dialogue, interaction and a creative spirit of inquiry appeared to provide the key to this effective solution. Vanessa appeared willing to invest the time and effort needed to solve the problem. Her interaction with the teacher showed that she was interdependent and flexible in her thinking and engaged in problem solving dialogue constructively. In solving the balancing problem, Vanessa could be seen to display those types of positive learning dispositions (EPIC) that are needed to cope with challenging and complex learning situations.

Teacher Observation 3
Katie showed real interest in developing a practical solution that would prevent a reoccurrence of the dilemma highlighted by the story. She had identified the important design factors of the task and appeared keen to implement the action plan she had developed. Katie was the type that could be seen interacting with the different materials teacher had provided before deciding on a particular course of action. She appeared to be independent in her approach and could be seen stopping at different times as if to check on her progress and how well she was doing. At a moment such as this, when the bridge tower was complete, Katie suddenly called out to the teacher...'does the counterbalance go to the top or bottom of the tower?' This most intriguing question was set to challenge the whole class after teacher decided they should work in groups to find the answer. Following much discussion and experimentation with different ideas and possibilities, a consensus of opinion was reached. Katie appeared pleased that she had raised the problem and had the opportunity to share it and make sense of it. Having decided how best to proceed from this point, Katie went on to complete this aspect of the task successfully.

In this problematic situation Katie showed that she was puzzled but had the confidence to speak out and share her confusion with the whole class. Her curiosity and interaction with the problem had seemingly provoked the question and she now appeared even more motivated to find an acceptable answer. In the process of solving the problem, Katie in effect was strengthening her own learning muscles and using the kind of learning dispositions that the EPIC framework is designed to promote: open-mindedness, exploratory behaviour, monitoring, flexibility ....



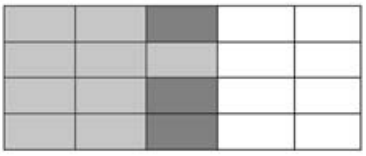
Appendix 3
Learning map based on the EPIC classification system

Domains of learning dispositions **Name of pupil:** Matthew

L1 L2 L3 L4 L5

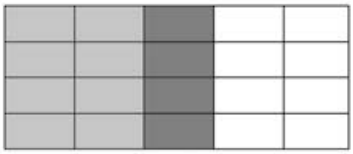
Expressive

Confidence: communicating an idea with clarity, accuracy and precision
Curiosity: attentive, interested, inquisitive, inquiring, problem posing
Open-mindedness: speculating and predicting, hypothetical
Responsiveness: interactive and participative, motivation and engagement



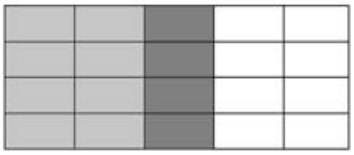
Productive

Exploratory: investigating and experimenting with ideas
Planning: deciding and prioritising action plan, settling goals
Applying: using what is known, extend understanding and apply new learning
Monitoring: checking progress and being reflective, in control of learning



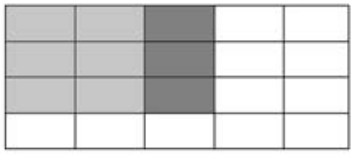
Innovative

Adventurous: trying out new ways of doing things, some risk taking
Flexibility: suggesting alternatives and considering different options
Creativity: creating, generating, imaginative and inventive, being resourceful
Evaluating: modifying and improving, suggesting better and more effective ways



Collaborative

Interdependence: working together, accepting responsibility, mutuality
Resilience: perseverance to make sense, make connections, reach conclusions
Sensitivity: empathy, tolerance, responsive understanding, suspending judgement
Coaching: assisting and guiding, supporting and encouraging, enabling



Key

Unaided **'Scaffolded' support**

L1 Reluctant to engage naturally, no exploratory / creative activity, practices avoidance tactics
L2 Engagement is haphazard, exploration not focused, easily distracted, a high teacher dependency
L3 Engagement is hesitant, explorations routine, requires probing and prompting
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L5 Engagement is continuous, open-ended and reasoned, autonomous and highly creative

Learning map based on the *EPIC* classification system

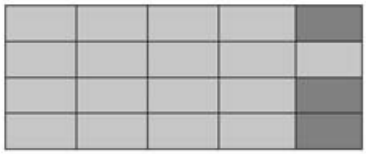


Domains of learning dispositions **Name of pupil:** Vanessa

L1 L2 L3 L4 L5

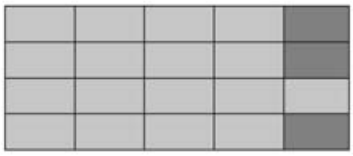
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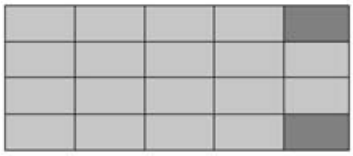
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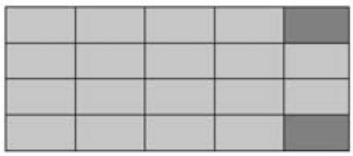
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Learning map based on the *EPIC* classification system



Domains of learning dispositions **Name of pupil:** Katie

L1 L2 L3 L4 L5

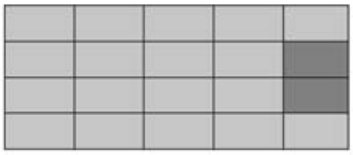
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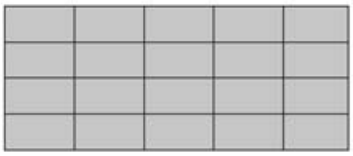
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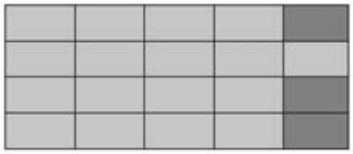
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