What makes ‘Meet the Scientist’ work

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Introduction

Aimhigher is a national government initiative working with young people, mainly in the 13 to 19 age group. Its objectives are to raise awareness, aspirations, attainment and progression (HEFCE 2008/05) of learners with potential to succeed, but who come from backgrounds underrepresented in Higher Education (HE). HEFCE 2007/12 explains, ‘overwhelmingly these learners are from lower socio-economic groups ...and those from disadvantaged backgrounds who live in areas of relative deprivation where participation in HE is low.’

In South West England three Aimhigher partnerships exist, one of which is the LIFE (Learning is for Everyone) partnership covering Dorset and South Somerset. The partnership has various strands which deliver activities in schools and colleges, including Science Technology Engineering and Maths (STEM). One of the most popular and fastest growing events offered by STEM is Meet the Scientist (MTS).

In this paper, research concerning the effectiveness of MTS in line with Aimhigher objectives is discussed. The research primarily takes a qualitative inductive approach using Grounded Theory. It is discovered that within the sample, four determinants of school engagement emerge. By using a matrix framework it is possible to demonstrate how negative factors leading to disengagement may be mitigated by the positive determinants.

This paper explores this matrix in conjunction with academic literature to provide the hypotheses that MTS works by increasing intrinsic motivation through freedom of choice and fostering relevance. It examines how evidence aligns with the findings of Assor et al 2002 regarding autonomy-enhancing teacher behaviour and school engagement, which has a positive effect on intrinsic motivation. Typically this is considered to be better than extrinsic motivation (Seale et al 2000). Locus of control (Verme 2009) is also considered.

This research is important for educational engagement particularly for widening participation where learners might have less intrinsic motivation for learning due to different aspirations such as those explained by Watts and Bridges 2006, Hogg et al 2004, and Archer and Leathwood 2003. It has implications for the classroom and other subject areas.

The MTS event

MTS involves PhD students from universities in the south of England, exhibiting their work to learners aged mainly between 13 and 16, in the form of short interactive presentations. This year exhibits have come from fields including organic chemistry, optical fibres, biodiversity, forensic biology, entomology, spacecraft propulsion, volcanology and echolocation. Learners arrive, receive an introduction, take a moment to look around and visit the exhibits of their choice. Often learners have done further preparatory work.

Scientists use various ways to engage learners and encourage participation, providing ‘hands on’ involvement in ‘real world’ projects. Materials are brought in such as larvae, ears preserved in alcohol and hairdryers used to keep ping pong balls airborne. Other methods to encourage engagement and participation include, showing videos, enacting experiments, drawing, questioning and storytelling about missions inside volcanoes.

MTS is now in its third year of running and is said to be highly successful in encouraging learners to continue studies in Science to Advanced Level or equivalent. One school reported a 40 per cent increase on the previous year. The number of learners participating has increased from around 200 in 2007, to 1454 in 2010 with the involvement of 11 schools and three colleges.

Demand for this particular intervention continues to grow, with a further five schools wishing to take part.

Brian Duke, Aimhigher in LIFE Partnership STEM Coordinator.

The meet the Scientist event was a huge success, students actively engaged with the range of post graduates and their specific projects. For many of our students it confirmed their interest in science related HE, but for some it was a true 'eye opener' and has made them go on to fully investigate the science opportunities that are out there for them. We hope to be able to have this as an annual event to inspire our future students. The staff felt just as inspired as the students so this was an additional bonus.

Nikki Sendell, Head of Science & Maths, Yeovil College.
Research methodology
The LIFE Partnership considered it necessary to conduct research to test these claims about MTS, evaluate impact and assess how it contributes to Aimhigher objectives.

This research primarily takes a qualitative inductive approach where evidence is used ‘as the genesis of a conclusion’ (Ritchie and Lewis 2006) opposed to using a deductive process where evidence supports a conclusion.

The main body of data is collected using Ethnographic methods, comprising of focus groups. Three groups were conducted to obtain learner’s views on the MTS event they attended, their education and future plans.

Morgan 1997, p. 8, explains ‘focus groups are largely limited to verbal behaviour and self reported data’ and recommends ‘if the goal is to collect data on social actions rather than just the discussion of these activities then the increased naturalism of participant observation is necessary’. In line with this participant observations were also undertaken.

Due to the nature of culture within schools Cohen et al 2007 advocates using mixed methods in order to assist with the interpretation of findings and obtain ‘rounded, reliable data’. In accordance with this data collection via focus groups and participant observation has been supplemented by self completion surveys taken by learners, teachers and scientists.

In conjunction with a review of academic literature, a hypothesis is generated from the data, using a classical grounded theory analytical approach (Glaser 2001). Cooney 2010 cited Annells 1997, deems grounded theory appropriate in explaining a focus on social processes, structures and interactions. Accordingly theories generated from this investigation, have emerged rather than being preconceived (Glaser 1993, Giske and Artinian 2010).

Research findings
Observations
The researcher attended a one day MTS event in November 2009. 172 learners and 14 scientists participated. The researcher also examined a video recording taken by a colleague at another recent MTS event. At both events learners and teaching staff were intensively interested in the exhibits and deeply engaged with scientists. Some learners were a little disengaged or shy of the Scientists to begin with but, gradually adapted to the environment as the presentations unfolded.
Scientists were very enthusiastic about their own projects and in disseminating information. Scientists engaged exceptionally well with learners and encouraged them to be involved, ask questions and think about their plans for their futures. This had a reciprocal positive effect which was apparent in learner’s non verbal communications demonstrating engagement and rapport. For example, learners sat forward and focused their attentions on the presentations and were willing to participate and contribute to discussions. There was no evidence of learners exhibiting behaviours such as having independent conversations whilst at presentations.

**Surveys**

172 learners participated in the MTS event attended by the researcher at a rural school. 132 of the learners completed surveys. According to learners, the most interesting thing was meeting and talking to the scientists. 29 per cent said they would like to study a science subject in the future and 88 per cent thought going to university would be good for their futures. This is very positive considering only 66 per cent thought going to university would be encouraged by their families and only 29 per cent thought their friends would go.

From the 13 teachers approached in 11 schools which had been involved so far for the year seven teachers completed surveys. They said MTS increased ‘awareness of science solving problems and what real scientists do’ and ‘made learners aware of possibilities in different fields of science’. The teachers reported how after the event they had ‘overheard things like, “I liked…best; … was really cool; it was much better that I thought it was going to be”. Both teachers and learners expressed that learners would have liked more time at the event.

14 scientists responded to surveys and provided some highly valuable comments including:

*Even students who are not interested in science leave somewhat inspired.*

*If I’d have had an event like this, I’d have a much easier time picking a career.*

*The only way for students to know if they should continue with education is to meet the scientists who actually show them how to apply it.*

*They found the subject very interesting, which inspired them to learn more. I think it gave them a reality check on what scientists are like as people.*
Many didn’t realise how much a science degree opens up so many career fields.

It gives them examples of scientific research and shows them it is often more interesting than their impression of science in schools.

Focus groups
Three focus groups were conducted at one school with learners in year 10, to obtain their views on MTS which they attended in November 2009 alongside views on their education and future plans. The first two groups were conducted 11 February and the third group was conducted 12 February. Group one comprised of four females and two males, group two comprised of four females and two males and group three consisted of four males and two females. Each focus group lasted for approximately half an hour.

What do you think about school?
Questions were asked to the groups to identify views about school, including what learners like and what they find difficult. Overall learners do enjoy school because it keeps them occupied and provides them with opportunities to socialise and make friendships.

I think if we didn’t have school we probably wouldn’t have most of the friends that we have right now.

I think it’s quite nice because you get to meet loads of new people.

Disengagement was highlighted in terms of learners feeling bored in lessons with listening and reading. They feel there is little interaction and would prefer to be elsewhere.

That’s how I feel, boring, just sitting down all the time and not like having anything to do, no interaction and stuff.

In some cases this is because they are not good at the subject, do not understand it, or see little future relevance of it. If subject content is perceived as difficult this can exacerbate disengagement. Similarly, learner’s experience of school is negatively affected by perceptions of teachers being too disciplinary or to speaking down to them.
RE [Religious Education] is pointless, it’s not my thing, I’m not very good at it and I don’t really understand it.

…we don’t find it’s going to help us in the future and you have to take an exam for it, when you could spend that time, an hour a week doing something else.

With Maths … you don’t know what you are going to do with it when you are older, so why do you need to learn it, because our parents never learnt it.

Engagement at school was found to be related to freedom of choice, such as with lessons coined as ‘Options’, where learners choose their own subjects. Learners would like to be able to undertake more options due to interest in subjects but also uncertainty about what they want to do in the future.

Options and choices are good because you can do what you want.

We were only allowed to choose one option, where as other schools had a couple, I wanted to do like Art or Music but I could only do Art.

I wasn’t sure what I wanted to do and I still don’t know, I think business because I thought that is what covers quite a lot if you do that and I thought it was good because I thought it was going to be really boring…I don’t know but it’s really really good!

Engagement is also enhanced by appreciation of the benefits of going to school, in terms of educational progression, employment opportunities and perception of subject relevance.

[School is] a good opportunity because if you get good grades then you can go on to university.

The fact that I know that I’m not going to be like working at [name of fast food restaurant] or something, I can get a job that I want.

It’s [Health and Social care option] just sort of preparing you for life because you learn about babies and stuff so it will give you an extra head start on how to look after children.
Teaching practices which facilitate positive communication with learners and relationship building is essential to engaging learners, particularly where subjects are perceived by learners to be difficult.

Learners engage well with teachers who are able to make associations between new information and amusing situations, thus enabling learners to understand and remember. It is evident that interest in Science has increased due to their current science teacher and his teaching style, which maintains attention, by being interesting, relaxed and humorous.

I do a lot of work in Science but that’s because there is a decent teacher behind it.

He’s like one of those teachers that just teaches you, like without you even realising…you actually learn something.

…he makes it stick in your head because he refers it to a joke and you instantly think of it when you can’t do it in an exam or something.

I wasn’t that interested in Science, I didn’t find it a very interesting subject and I didn’t really like it!

I’ve only had him for this year and I really enjoy Science now!

He lets me makes comments and everything and just laughs at them.

I think before, before I came to this school, like, had Mr [teacher’s name] and all these practical’s and everything like, I really didn’t care for Science.

He puts humour into Science and it’s just proper, it’s brilliant!

And he’ll sort of go on about a story but it will help us, with the story.

What are you interested in doing when you finish school?
Learners were asked questions to establish what they were interested in doing when they finish school and why.
Aspirations for going to university exist. There is also a perception that going to university is still a preference in the absence of any specific ambitions.

- I think I want to go to [name of university] and do media.
- I’d like to go to college and university but don’t actually know what I want to do.
- I’m just going to go to university, probably, don’t have a clue.

Positive views were also expressed concerning progression after compulsory education and beyond. However, uncertainty was still apparent amongst some learners and was provided as a good reason for going into 6th form along with social and comfort motives.

- I’m going to go to 6th form, I think it’s good.
- You will get a bit more knowledge about what you want to do.
- I wouldn’t mind going to either [6th form or college] but you know just mainly 6th form because it’s part of [name of current school].
- I think I just want to go in 6th form because it’s familiar, not because I like it better.

Contrary to this, views were expressed that 6th form is for those who want to re sit particular subjects. Other learners expressed firm aspirations to leave school, because they wanted to do specific subjects at college, because they did not like school or wanted to do something different.

- I’m going to [name of college] to do sport.
- I want to leave the school as soon as possible.

**What did you think about the MTS event in November?**

Overall learners engaged well with MTS, which increased their interested and awareness in science. Learners explained they were able to remember what they learnt from the event because it was ‘different’, ‘hands on’, practical, visual and interactive.
I found it really interesting like when I first got in I didn’t think it would be what I would enjoy and I went in there and we sat down and it was so good I found it really interesting.

You can actually get to hold stuff and look at stuff instead of just sitting there.

I think if they did that for subjects we were learning it would really help you remember stuff. Because I can remember everything he said really well.

It’s different to just [being] sat there and watching the slide show to actually talking to them.

Learners were able to see science at work and its application to the real world, whilst experiencing positive, rapport building interaction with the scientists.

They made it sound really interesting.

And they are all like interesting people they didn’t just sit there like this is this and this is this.

They were quite a laugh!

Engagement may also have been harnessed by factors that triggered emotive responses to the exhibits such as amusement, amazement, horror and surprise. The exhibit one learner found most interesting was the funny little car thing, that doesn’t go straight.’ Someone else preferred the ‘frog man’, who was tall with frizzy hair and ‘was going on about poison and stuff on the frog.’ Learners also enjoyed the ‘ear’ exhibit, ‘looking inside of an ear, an actual dead inside of an ear!’ Someone else thought this ‘was horrible!’ Learners were particularly impressed by the Forensic Science.

We were just all so shocked that they could tell so much from just like bugs!

He could tell from like flies and the maggots in the body, what time they died!

What time they died and like where they were from because they had that man from Peru didn’t he, and he knew he was from Peru by the bugs on him!
We found that one really interesting. That's not something we would do in our normal Science.

The event was such a success that learners would have liked it to have been longer, enabling them to visit all displays.

I didn't get to see all the stuff that I wanted to see.

You could see other people on them and it looked really good but you didn't have time to go over there.

I ended up, me and a group of friends ended up sitting behind where everybody had left so we could finish the presentation and ended up getting in trouble for it.

Awareness of science subjects, courses and careers was also increased as well as grades required and the work involved.

I didn't realise there were so many options for Science. 
It showed us what colleges and universities there were.

And they told you what you needed to get on the course at the end of it and stuff.

There were some views expressed that MTS did not help learners, learners did not know how the event helped them or it did not help with career choice. This was largely because these learners were not interested in science related careers anyway, or they did not realise that their preferred careers were science related.

It didn't help me choose a career but it helped me sort of learn about the different options in Science careers.

I don't think its like changed what I think I want to do when I'm older because I don’t want to do anything with Science……I want to be a nurse.

Can you explain how you would feel about working in science as a career?

Some learners felt they would learn a lot from a science career and it would be fun, particularly forensic science. However, others thought it would be hard, boring and lots of
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paper work. Views were also expressed that learners would not want a career in science as it is not a preferred subject. Learners explained that even though they may not be interested in science they still found MTS interesting and useful. MTS made learners more open to considering science as an option.

_Probably my second option if I don’t do media._

_In the 6th form you get to move on to forensics and stuff ……. so besides any other options it could be something that I do._

_A lot of people don’t find science interesting, but like, it’s not something that I’ve always wanted to do, but I’m not that interested in Science, but I found what they did interesting, it was so much more like hands on._

**What kinds of things would stop you from going to university?**

Money concerns appear to be the main issue that would stop learners going to university, amongst others including deadlines, coursework, grades and balancing personal interests and other ambitions.

_I think it’s good because like if you want to do something like university and stuff, if you want to do law or something then university is obviously, you would have to go, but I just think it’s too much money._

_You have to pay that student loan back and it’s just like really daunting._

_They have lots of loans and stuff and then once you finish university and have done what you wanted to do, you have to pay that back._

_One thing that probably would stop me…, in particular, if say… I got somewhere with my band then I could say well I have got more chances of like going somewhere with this rather than that so I would just drop university and go on with the band._

Some learners felt that their parents would pay for them and felt confident about grades. Learners understood the importance of grades particularly with reference to Maths, English and Science. However this could work adversely to discourage those who are not good at such subjects.
I think my parents paid for my brother when he went to college, so hopefully they will for me.

There were also views regarding other types of routes and aspirations. One learner explained that they were going to go to university but wouldn’t if they could get on an early apprenticeship. Another learner aspired to being a nurse in the Army.

Learners did not seem to be worried about leaving home. There were views expressed that learners would in fact be happy to leave home and would not miss their friends. However other learners said they would not go too far away.

If I did go to university it would be at [name of university] or like somewhere not too far away.

Educational, employment, social and developmental benefits are realised as are the likely benefits, which make learners aspire to progress to university.

[Name of university] has one of the best media courses and that’s what I want to do so that’s why I want to go to university.

Yeah and then it will give you like a wider opportunity, If you go to Uni you are bound to get a good job that pays well so it would be worth it.

It will probably help you mature as well, see what the real world is like.

I think it’s a good experience as well like moving away, like if you stay there away from home its good.

And like you meet new friends there and they are doing something different that you might find interesting as well so it could like help you make the right decision as to what you want to do.
Analysis

Analysis of primary data

When the findings from participant observations surveys and focus groups are triangulated, results are coherent. Focus group discussions of social interactions are validated. MTS aligns with Aimhigher objectives in raising awareness and aspirations and is said to affect attainment and progression. MTS has increased interest in science even amongst those who are not considering science as a future option. It has increased awareness and understanding about real world science. Aspiration for going to university exists even when there is uncertainty over subject and career choices. The general positive perception around going to university is mitigated by financial concerns.

Learners enjoy school for social reasons. This research identifies main determinants of school engagement; freedom of choice, subject relevance, learner capability and positive teaching style. These determinants along with their positive or negative impact can be plotted on a matrix (Figure 1) against subject area.

Where determinants are perceived to be negative, disengagement can occur. The matrix framework demonstrates how negative determinants may be mitigated by the positive. In option lessons freedom of choice and relevance exist. Teacher communication is positive and the subject is not difficult. In maths, there is no freedom of choice or relevance. There is poor teacher communication and the subject was considered difficult. With science lessons, freedom of choice or relevance is not mentioned. There was positive teacher communication which seemed to overcome other challenges. A solution to improving engagement in maths, for example would be to explain relevance of the subject using real world examples and provide elements of choice.
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**Review of academic literature**

The two main types of motivations for learning are identified as intrinsic and extrinsic. With intrinsic motivation, ‘relevance of the content is the primary driving force’, with extrinsic, ‘relevance of the learned material is of secondary importance’. ‘Typically, intrinsic motivation is seen as better than extrinsic motivation’ (Seal et al 2000, p.614).

Learners who have genuine interest in a subject may therefore have greater motivation for learning than those who want to learn for other reasons. For maximum learning motivation to exist, learners need to appreciate subject relevance. ‘Teacher behaviours that help students to understand the relevance of schoolwork for their personal interests and goals are particularly important predictors of engagement in schoolwork’. (Assor et al 2002, p.261).

The author explains how perceptions of actions ‘assisting in the formulation and realisation of personal goals and interests’ are likely to ‘evoke positive feelings’, whereas the perceptions of actions interfering with personal goals and interests ‘is likely to evoke negative feelings’. This is evident from the primary research in this study where learners have negative attitudes to subjects such as religious education and maths but positive attitudes towards options.

How learners view the amount of control and freedom of choice they have towards their actions and outcomes also affects school engagement. Burlin 1976 and Verme 2009, explain the concept of Locus of control where individuals are categorised as either internals, believing the outcome of their actions will be dependent upon their effort and skills or externals, believing the outcomes are dependent on destiny. Burlin found internals had higher occupational aspirations than externals and suggests that internals are more likely to be able to free themselves from potentially negative external constraints, such as those of background and tradition. Verme 2009, p.146, found internals to be happier than externals and suggests internals ‘have a greater appreciation of freedom of choice’. This suggests that relevance is more important than freedom of choice when engaging learners as not all learners will be internals and value freedom of choice. This is supported somewhat by Assor et al 2002, p. 261, who states ‘choice is good, but relevance is excellent’, because there may be ample choice of irrelevant tasks.

Assor et al 2002, p. 263 found that if at least two autonomy-enhancing teacher behaviours were present, fostering relevance, acknowledging students’ negative feelings or providing choice, there was a significant positive effect on intrinsic motivation. This is seen in the primary research conducted where MTS brings science into the real world, where the science teacher allows learners to comment and where learners choose options. It is also noted, in order to foster relevance teachers need to ‘understand students’ goals interests and needs and then to link school tasks to those’, (Assor et al 2002, p.261).

In contrast, provision of choice may be essential in producing relevance, particularly when working with different learners. Watts and Bridges 2006, p.267, explain, non participation in HE ‘is not simply a matter of low aspirations but that it may arise from different aspirations ...HE is not necessary to enable these young people to achieve those things they aspire to and value’. The current research findings demonstrate aspirations for other progression routes such as apprenticeships and the army.

Different goals, interests and needs are also evident when considering financial implications and debt. Archer and Leathwood 2003, suggest ‘the balance between the potential benefits weighted against risks and costs of participation are differently structured across social class ...this may translate into working class perceptions of HE participation as entailing higher costs and uncertain rewards’.
Issues also exist around social identity, group conformity and social acceptability. Verme 2009, p.150, identifies how ‘people make judgements on the relative position they occupy within a reference group’ thus justifying why ‘happiness does not increase consistently with income over time’. Archer and Leathwood (2003, p.180) propose ‘the achievement of manhood for working class men may be closely linked with the achievement of secure, skilled work both as a source of income and of social status’.

Consequently such issues will impact on learners, leaving previous peer groups, adapting and being accepted back into former communities. ‘People strive to reduce subjective uncertainty about their social world and their place within it,’ (Hogg et al 2004, p.256).

Perception of intelligence is also apparent. Ahmavaara and Houston, 2007, p.626) found ‘intelligence theory affects aspirations indirectly through perceived academic performance, confidence and self esteem’ and ‘intelligence theory affects aspirations directly’, as in the current research where learners perceive themselves not to be good at particular subjects. Conversely, the same learners did not previously perceive themselves to be good at science until they had a teacher whose teaching style effectively engaged them.

**Conclusion**

This research has investigated MTS in line with Aimhigher objectives and has found four drivers of school engagement emerging. In accordance with the grounded theory approach taken, a visual theory is produced in matrix form and it is hypothesised that MTS works by increasing intrinsic motivation through freedom of choice and fostering relevance. Learners whose motivations are primarily extrinsically motivated are likely to become more intrinsically motivated to continue with some kind of studies in science after having attended MTS.

The academic literature review has demonstrated that there are many factors that impact on intrinsic and extrinsic motivations. Fostering relevance is the primary driver for school engagement however this may be encouraged by the provision of relevant choices relating to individual learners’ goals interests and needs.

**Limitations**

The views in this report are only those views of this group. Inferences cannot be made to the wider population or other learners in other groups or other locations due to the limited sample size.
Recommendations
Further research should be undertaken to test the validity of the Learning Motivation Matrix and the hypothesis that MTS works by increasing intrinsic motivation through freedom of choice and fostering relevance. Events for other career areas should be held using the same format as MTS. Advice and guidance is needed regarding finance and progression routes, particularly with reference to routes other than university, as well as how to peruse those routes.

References


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