

# Independent research at A level: Students' and teachers' experiences

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## Background

### The A level system in England and Wales

In this article we explore the opportunities that exist to conduct independent research at A level, from the perspectives of both teachers and students. In England and Wales, most 16 to 18 year old students wishing to take a non-vocational educational route follow courses leading to A level qualifications (Advanced Level General Certificates of Education). These courses are available in over 45 different subjects ranging from physics to philosophy (Ofqual, 2011), and are studied over two years: the Advanced Subsidiary (AS level) component in Year 12, and the A2 component in Year 13. Most students take between three and five subjects in Year 12 (at AS level) and typically drop one subject to continue with the remaining three or four subjects in Year 13 (at A2 level) (Vidal Rodeiro, 2007). The A level system provides a very common route into higher education and employment. The nature of the skills and knowledge that students develop through their A level courses therefore has important implications for the ease and success of these transitions (Wingate, 2006; Marland, 2003).

In contrast with educational systems for similar students in other European countries (for example, the German Abitur and the French Baccalaureate) and internationally (for example, the International Baccalaureate, IBO, 2011), the A level system is quite specialised (DfES, 2005). Students study relatively few subjects, but have the opportunity to do so in depth. Unlike almost any other educational system for 16 to 18 year olds in the developed world, no subject is compulsory (Porkess *et al.*, 2011); instead students may focus exclusively on the sciences, the humanities, modern foreign languages, or may choose a diverse combination of subjects if they wish. Awarding bodies administering the qualifications state that over a two-year period, students should receive 360 guided learning hours for each subject that they study (OCR, 2011; AQA, 2011), which amounts to at least five hours' teaching per week. Students are also expected to put in many hours of private study outside the classroom.

Whilst critics of the A level system have raised concerns that it forces students to specialise at too early an age and provides too narrow an education (Tomlinson, 2004), a potential benefit of A level courses may be their conduciveness to independent research and investigation. Arguably, A level students should have greater opportunities than should some of their European counterparts to engage in deep thinking and investigative work within their subjects.

### Independent research and investigative skills

The research literature contains a mixture of conceptions of independent research and investigative skills. There exists no single system of classifying skills in this broad domain, and terms are often used

interchangeably. Within the cognitive domain of Bloom's (1956) taxonomy of educational objectives, analysis, evaluation, and synthesis/creation have been positioned at a high level within a hierarchy of cognitive skills (Anderson and Krathwohl, 2001). All three 'higher order' skills are used extensively in independent research and investigative activities, are valued highly at university, and relate closely to some '21st Century skills' such as critical thinking, problem-solving, decision-making, and innovation (for discussion see Silva, 2009; ACT21S, 2011). More tangible skills asserted as being important for research and investigation include: locating information using appropriate sources, determining the scope of tasks, recording and organising findings, and keeping material relevant to the original research question (O'Sullivan and Dallas, 2010). Other authors have explored the nature of independent learning. Skills considered relevant to this related concept include: planning, prioritisation, time management, getting started on assigned tasks, and organisation (Smith, 2004; Wingate, 2006; O'Shea, 2010).

Embedding opportunities within academic A level courses has not been the only approach to developing independent research and study skills. O'Sullivan and Dallas (2010) describe a collaborative project in the US, between an English teacher and the school librarian, which aimed to prepare high school students for higher education by providing them with a 'research paper' class within the general secondary curriculum. The class offered students structured guidance in selecting a topic, gathering information, and organising the information into a 10–15 page research paper. The general objective was to foster skills such as critical thinking and problem solving. In the UK, the Extended Project Qualification (EPQ) has been developed explicitly to provide students with an opportunity to develop project management skills, including planning, accessing information from a range of resources, analysing, organising and integrating findings (OCR, 2011). Students' projects culminate in 5000-word dissertations, or in shorter reports accompanying artefacts such as works of art or music. They may be on any topic, and are conducted alongside study for A levels or vocational qualifications. Other approaches include the extended essay written by students working towards the International Baccalaureate Diploma (IBO, 2011), and the British Science Association's (2011) scheme of Crest awards for projects in mathematics and science.

Whilst the above schemes have proven valuable to many students, key concerns for educationalists and policy makers relate to the equality of provision and access. Given that university tutors claim some new undergraduates are not ready for higher level study, having been spoon-fed material at school and college (Kajander and Lovric, 2005; Rees and Wilkinson, 2008), it is clear that not all students are benefitting. Although project schemes such as EPQ are funded by the state, uptake is mixed. Some individual schools and colleges go to considerable lengths to support students undertaking projects of various types, whereas others

restrict themselves much more to traditional curricula, or offer alternative forms of extracurricular activities with alternative associated benefits. Arguably, therefore, it is important for staple courses such as A levels to provide opportunities for independent research and investigation too. This may help to level the playing field at a time of intense competition for university places (Richardson, 2010, November) and employment.

It is important to note that *perceptions* of the opportunities provided by specific A level courses may vary among teachers. Although some subjects may not easily lend themselves to independent research and investigation, creative teaching and assessment approaches could bolster opportunities for students. Even in the case of the subjects that do lend themselves better to independent research, there are other factors related to the institution, the culture of the school department, teaching style and individual characteristics which determine whether students will develop such skills successfully (Lovitts, 2005). Classroom-based action research by Stohl (2010), for example, indicated that questioning and focussing on inquiry played an important role in developing important characteristics and skills among students, including: autonomy, motivation, self-confidence, independent learning and knowledge-seeking.

Further concerns over equality of opportunity relate to the availability and usage of the practical resources needed to develop research and investigative skills, as well as the advice and guidance that students receive when using them. Although many students in the 21st Century have access to extensive information via the internet, recent studies have indicated that students' ability to locate specific information and use that information appropriately is often rather weak (Owen, 2010; Salisbury and Karasmanis, 2011). McClure and Clink (2009) found that students rarely pay attention to aspects such as timeliness, authority and bias while gathering information from online sources. They found that teachers face a challenge in encouraging their students to attend to these crucial issues.

## The present study

The aims of the present study were to explore teachers' and students' experiences and perspectives of independent research at A level. The study focused on three contrasting but mainstream A level courses: Economics, French and Mathematics. These three subjects were selected for investigation because they are relatively popular subjects, available for study in most types of schools and colleges for 16 to 18 year olds, and they contrast with one another. Three main issues were investigated: (i) the extent to which teachers think research and investigative skills can be developed at A level; (ii) the resources and formal guidance that students use; and (iii) whether subject-specific differences arise. The study contributed to a wider project on teaching and learning at A level, which explored related issues such as teaching beyond the syllabus (Suto *et al.*, 2011), reasons for subject choice (Mehta *et al.*, 2011), and class size (Rushton *et al.*, 2011). A questionnaire and follow-on interview methodology was used to collect data, which were analysed quantitatively and qualitatively.

## Methods

### Questionnaires

Two questionnaires were developed: one for teachers and one for students in Years 12 and 13 (aged 16 to 18). Ideas for themes to be

explored were generated from a series of brainstorming meetings held with subject experts and other researchers. Questions were constructed which covered all the identified themes and extended draft questionnaires were assembled. These were then refined by removing or rewording questions which seemed less likely to generate meaningful responses, and by incorporating instructions and a consent form at the start.

The draft questionnaires were piloted in a local school by a teacher and two students. The teacher was asked to complete the teacher questionnaire and then to comment on the following areas:

1. Typing mistakes or grammatical errors
2. Ambiguous questions
3. Terminology of the questions (words which were not understood or unclear phrases)
4. Multiple choice answers
  - a. Suitability of answer options
  - b. Missing answer options
  - c. Extraneous answer options

The two students were instructed to fill in independently the student questionnaire and then give feedback in response to:

1. Understanding of what each question was asking
2. Words used which were not understood
3. Ease of answering each question

The teacher was also asked to provide general feedback about the student questionnaire.

Several suggestions were received in the pilot, including: additional response options, changes to wording to clarify what was being asked, and indications of where more space was needed for the free text responses. This feedback was used to amend some questions. The overall length of the questionnaires was also reduced by removing some questions. The amended versions of the teacher and student questionnaires were reviewed by subject experts and other researchers.

Once each questionnaire had been finalised, separate versions were created for Mathematics, Economics and French. These differed only in the subject name used throughout.

In the teacher questionnaire, respondents were asked to indicate the frequency with which carrying out an investigation/research is set as: (i) classroom activity, and (ii) homework/private study. Respondents were asked to tick the most relevant option from: *twice a week or more, once a week, once a fortnight, less often, and never.*

In another question, teacher respondents were asked:

*To what extent are your students required to utilise independent research skills during the course?*

This was a multiple choice question and teachers were asked to tick the most relevant option (explained in the results section).

Teacher respondents were also asked to show their agreement with the following statement:

*The course enables students to develop research and investigative skills that are useful in higher education*

The response options to this question were: *strongly agree, agree, neither agree nor disagree, strongly disagree, and not applicable/don't know.*

In the student questionnaire, (in a question very similar to one in the teacher questionnaire,) respondents were asked to indicate the frequency

with which they were asked to carrying out an investigation/research as: (i) classroom activity, and (ii) homework/private study. Respondents were asked to tick the most relevant option from: *twice a week or more, once a week, once a fortnight, less often, and never.*

In another question, student respondents were asked:

*If you are asked to carry out independent research in your subject, who or what would you consult? (e.g. the internet, TV, your parents, etc.)*

This was an open-ended question. Students were provided with space for a free text response.

Three recruitment samples were identified for the survey: 200 schools and colleges following an A level Mathematics course; 100 schools and colleges following an A level Economics course, and 100 schools and colleges following an A level French course. (All three courses were administered by a major awarding body (OCR, 2011), who provided the research team with contact details.) There was no overlap between the three recruitment samples. Each sample was stratified in order to represent the full A level population for that course in terms of social deprivation, academic achievement and school/college type, as measured by indicators derived using data from the National Pupil Database.

Letters of invitation were sent to Heads of Department at the identified schools and colleges, explaining the key aims of the study and what participating would entail. Two copies of the appropriate teacher questionnaire and ten copies of the appropriate student questionnaire were enclosed, together with a pre-paid envelope in which questionnaires could be returned. The centres were encouraged to ask for additional questionnaires if needed and were given six weeks to complete and return the questionnaires.

## Interviews

Following the survey, interview schedules for teachers and students were developed for probing more deeply into some issues which were considered to be in need of clarification or further exploration. A further purpose was to corroborate the questionnaire results. The schedules were piloted on one teacher and one student and a final version was produced which incorporated feedback from the pilot. All the teachers and students who had consented in their questionnaires to be contacted for a further phase of the project were identified. Two teachers (one teaching Economics and the other French) and nine students (four studying Economics and five studying French) were selected at random and were interviewed about their experiences. All interviews were carried out in interviewees' own schools and colleges by experienced interviewers. Each teacher interview took an hour to complete and each student interview lasted 30–40 minutes. Each interviewee completed a further consent form before beginning the interview. The interviews were recorded and were subsequently transcribed.

## Results

### Characteristics of questionnaire respondents

Forty Mathematics departments responded to the survey, returning 47 teacher questionnaires and 299 student questionnaires. Eighteen Economics departments responded, returning 24 teacher questionnaires and 228 student questionnaires. Twenty-one French departments responded to the survey, returning 15 teacher questionnaires and 136 student questionnaires. To ascertain the representativeness of the

data collected, key background characteristics of the responding schools and colleges were compared with those of the full populations of schools and colleges from which the recruitment samples were originally drawn. In terms of performance on examinations and economic deprivation (as determined by the postcodes of the responding schools and colleges), the samples of respondents were broadly representative of the full populations.

Table 1 enables comparisons to be made between the school/college types of the responding samples and the full A level populations for the three subjects. It can be seen that the sample of responding Mathematics schools/colleges seems broadly representative of the full population in this respect, although it comprises slightly smaller proportions of independent and selective state schools. The responding Economics sample comprised no Further Education colleges, proportionately more sixth-form colleges, and proportionately fewer independent schools than the full A level Economics population. The sample of responding French centres comprised no sixth-form colleges, proportionately more selective state schools, and proportionately fewer independent schools than the full A level Economics population. However, given the sample sizes (Mathematics = 40; Economics = 18; French = 21) a few differences of this kind are unsurprising. The sample was deemed sufficiently representative of the full population to be useful.

**Table 1: Types of centres responding to the questionnaire**

School/ college type	Mathematics		Economics		French	
	% of responding schools/ colleges	% of full A level Mathematics population	% of responding schools/ colleges	% of full A level Economics population	% of responding schools/ colleges	% of full A level French population
FE College	5	3	0	9	5	3
Sixth-form College	8	9	22	12	0	4
Indepen- dent	15	24	22	30	14	27
Selective state	15	9	11	8	29	13
Compre- hensive	57	55	45	41	52	53

### Data from teachers

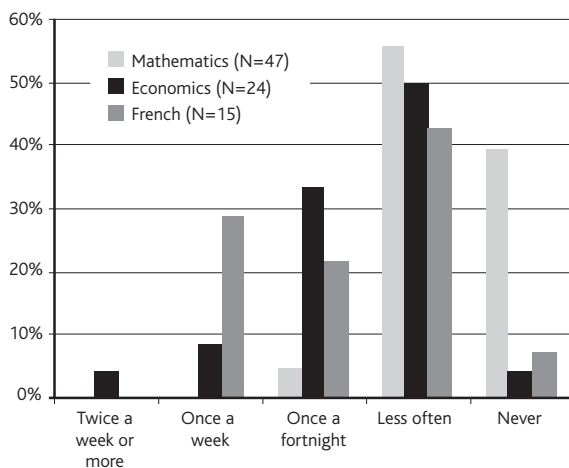
*The frequency with which students are asked to carry out investigation/research in the classroom and as homework/private study – teachers' responses*

Table 2 and Figure 1 show that about half of the responding Economics and French teachers were setting investigation/research as a classroom task once a week to once a fortnight. In comparison, the Mathematics teachers reported setting this task less often for their students. While there are examples of good practice for engaging students in independent research/study in Mathematics (Hernandes-Martinez *et al.*, 2011), it appears that such activity may be relatively uncommon.

Table 3 and Figure 2 show that trends in the provision of opportunities to carry out investigation/research as homework or private study are similar to those in the classroom context. Once again, the Economics and French teachers were asking students to carry out more independent research than were the Mathematics teachers. It should be noted that

**Table 2: The frequency with which students are asked to carry out investigation/research in the classroom – teachers' responses**

	Mathematics (N=47)	Economics (N=24)	French (N=15)
Number of responses	43	24	14
Twice a week or more	0	1 (4.2%)	0
Once a week	0	2 (8.3%)	4 (28.6%)
Once a fortnight	2 (4.7%)	8 (33.3%)	3 (21.4%)
Less often	24 (55.8%)	12 (50.0%)	6 (42.9%)
Never	17 (39.5%)	1 (4.2%)	1 (7.1%)



**Figure 1: The frequency with which students are asked to carry out investigation/research in the classroom – teachers' responses**

although students were being asked to carry out independent research both in the class and at home, the teachers presumably had less control over how the students were carrying out assigned tasks at home and to what extent they were carrying them out entirely independently.

*Teachers' views on the extent to which students are required to utilise independent research skills during their A level courses*

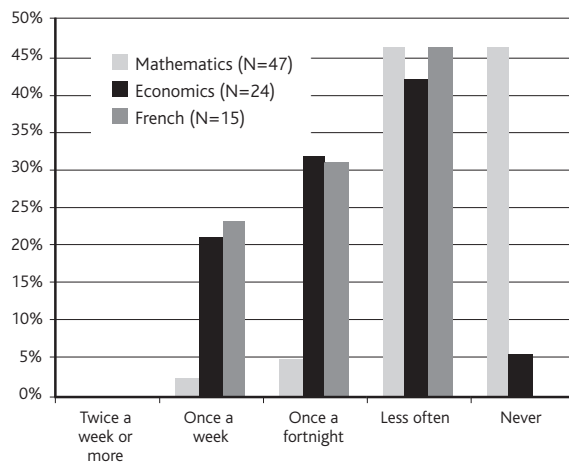
Table 4 and Figure 3 show that the majority of the French teachers felt that their course offered some opportunity to develop independent research skills. More than half of the Economics teachers also took this view. However, the majority of the Mathematics teachers felt either that their Mathematics course did not require an independent approach on the part of the students, or that little emphasis was put on independent research skills. These data corresponded well with the teachers' responses to the previous question. It is also interesting to note that one Mathematics teacher and two Economics teachers believed that their course fostered independent research throughout its entirety (Table 1). Although in general, teachers felt that Mathematics does not appear to lend itself that easily to the development of independent research skills, there were a few Mathematics teachers who disagreed.

*Teachers' views about whether their courses enable students to develop research and investigative skills that are useful in higher education*

The teachers' responses in Table 5 and Figure 4 show that of the three subjects, French teachers agreed the most with the view that their course

**Table 3: The frequency with which students are asked to carry out investigation/research as homework/private study – teachers' responses**

	Mathematics (N=47)	Economics (N=24)	French (N=15)
Number of responses	41	19	13
Twice a week or more	0	0	0
Once a week	1 (2.4%)	4 (21.1%)	3 (23.1%)
Once a fortnight	2 (4.9%)	6 (31.6%)	4 (30.8%)
Less often	19 (46.3%)	8 (42.1%)	6 (46.2%)
Never	19 (46.3%)	1 (5.3%)	0

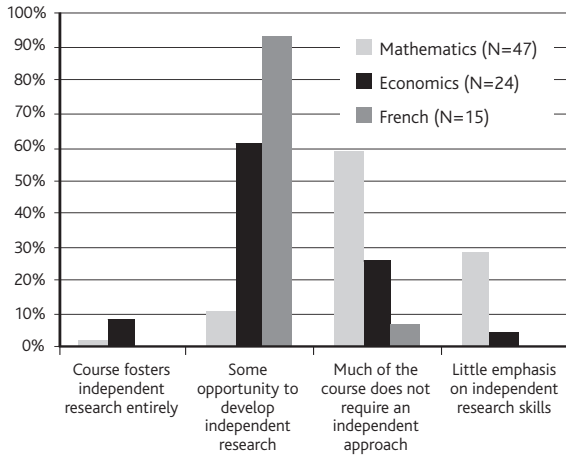


**Figure 2: The frequency with which students are asked to carry out investigation/research as homework/private study – teachers' responses**

enables students to develop research and investigative skills that are useful in higher education. In contrast, the majority of Mathematics teachers disagreed with the view. Of those teachers who disagreed, it is not possible to identify whether the cause of their disagreement was

**Table 4: The extent to which the students are required to utilise independent research skills during the course – teachers' responses**

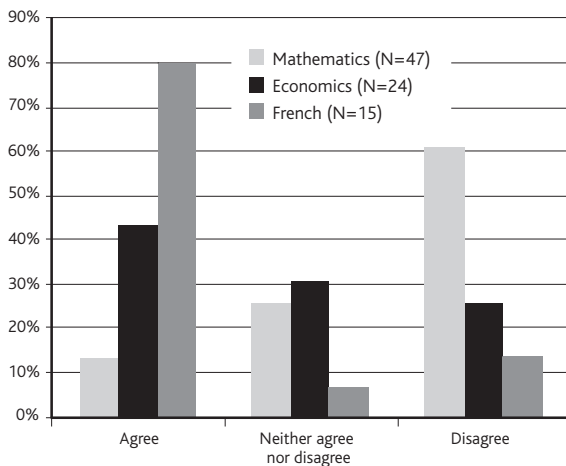
	Mathematics (N=47)	Economics (N=24)	French (N=15)
Number of responses	46	23	15
A. The course fosters independent research throughout its entirety	1 (2.2%)	2 (8.7%)	0
B. The course offers some opportunity to develop independent research skills	5 (10.9%)	14 (60.9%)	14 (93.3%)
C. Much of the course does not require an independent approach on the part of the students	27 (58.7%)	6 (26.1%)	1 (6.7%)
D. Little emphasis is put on independent research skills in the course, and these skills are not significantly developed by the students	13 (28.3%)	1 (4.3%)	0



**Figure 3: The extent to which the students are required to utilise independent research skills during the course – teachers' responses**

**Table 5: Teachers' views about whether their course enables students to develop research and investigative skills that are useful in higher education**

	No. of responses	Strongly agree/Agree	Neither agree nor disagree	Strongly disagree/Disagree
Mathematics (N=47)	46	6 (13%)	12 (26.1%)	28 (60.9%)
Economics (N=24)	23	10 (43.5%)	7 (30.4%)	6 (26.1%)
French (N=15)	15	12 (80%)	1 (6.7%)	2 (13.3%)



**Figure 4: Teachers' views about whether their course enables students to develop research and investigative skills that are useful in higher education**

about the course enabling the development of research and investigative skills or about those skills being useful in higher education. These two aspects need to be explored separately in future research.

During the interview stage of data collection, the Economics teacher who was interviewed indicated that while she did not get much chance to develop independent study skills, she tried to encourage her students to use different resources for information. Additionally, she also facilitated debates amongst her students to allow them to get used to uncertainty, that is, to become aware that many situations do not have one obvious correct answer and also to realise that different perspectives could exist in relation to the same situation.

The French teacher explained in the interview that in her school they

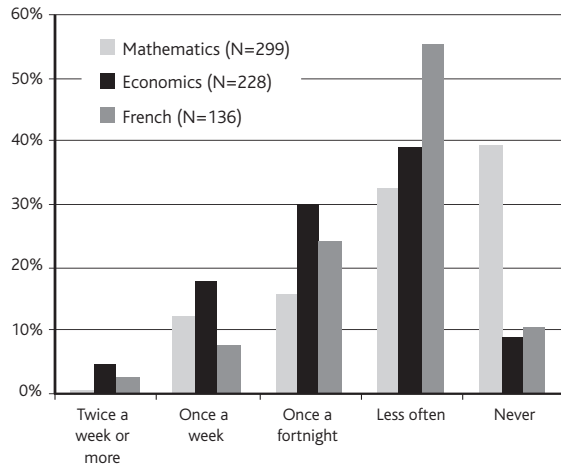
had a tutorial system in place to discuss study skills, organisational skills and independent learning with their students. She also explained that independent study skills were not treated as a separate entity and were an integral part of various activities, for instance, in students choosing what they wanted to read and also being encouraged to explore the latest news.

Overall, the teacher questionnaire and the interview data indicate that independent research is certainly taking place at A level, although to a greater extent in French and Economics than in Mathematics. It also suggests that students are being encouraged to develop independent research skills in a variety of contexts.

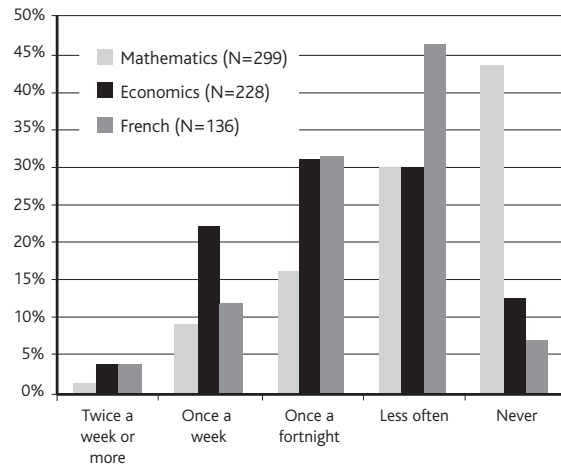
### Data from students

#### *The frequency with which students are required to carry out investigation/research in the classroom and at home – students' responses*

Figures 5 and 6 show that more French and Economics students than Mathematics students responded that they carried out research, both in the classroom and as homework or private study. This finding is in line with the teachers' responses (see Figures 1 and 2). However, it is notable that more Mathematics students reported carrying out investigation and research (both in the class and as homework) than their teachers indicated. One possible explanation for this difference in students' and teachers' responses might relate to differences in teachers' and students'



**Figure 5: The frequency with which students are asked to carry out investigation/research in the classroom – students' responses**



**Figure 6: The frequency with which students are asked to carry out investigation/research as homework/private study – students' responses**

understanding of what constitutes research and investigation. The teachers may have been more inclined to respond according to the number of times the task was set, whilst the students may have been influenced by how long it took them to complete tasks, especially if they carried out the work over a number of occasions. Since the questionnaire did not include questions exploring the differences in teachers' and students' definitions of independent research, it is not possible to provide a concrete explanation for this difference in their results. However, this strand could be explored in future work.

#### Sources consulted for information while carrying out independent research – students' responses

Table 6 shows that across all three subjects, the internet was the most widely used resource that students reported consulting if asked to carry out independent research. However, the internet is an extremely broad area and the students did not really explain how they were using the internet to facilitate their independent research. Table 6 also shows that a greater percentage of Mathematics students reported consulting their teacher in comparison with Economics and French students. Some students across all three subjects reported seeking help from friends or family. A greater percentage of French students indicated referring to magazines compared to Mathematics and French students. A greater percentage of Economics students than French students mentioned referring to the newspaper. Mathematics students, on the other hand, did not appear to use this source at all. A few students studying Mathematics

**Table 6: The sources students consult for information while carrying out independent research**

	Mathematics (N=299)	Economics (N=228)	French (N=136)
Number of responses	267	220	135
Internet	217 (81.2%)	213 (96.8%)	132 (97.7%)
Teacher/tutor	65 (24.3%)	14 (6.3%)	10 (7.4%)
Textbooks	64 (23.9%)	55 (25%)	23 (17%)
Other books	44 (16.4%)	45 (20.4%)	41 (30.3%)
Family	42 (15.7%)	28 (12.7%)	27 (20%)
Friends/peers	33 (12.3%)	15 (6.8%)	10 (7.4%)
Library	15 (5.6%)	10 (4.5%)	11 (8.1%)
Notes/Revision material	15 (5.6%)	8 (3.6%)	6 (4.4%)
Television/videos	7 (2.6%)	23 (10.4%)	17 (12.5%)
Exercise books	4 (1.4%)	0	0
Intranet	2 (0.7%)	1 (0.4%)	0
Magazines/articles	1 (0.3%)	23 (10.4%)	22 (16.2%)
Work	0	0	1 (0.7%)
Newspaper	0	47 (21.3%)	17 (12.5%)
Not asked	5 (1.8%)	0	0
Don't do	8 (2.9%)	0	1 (0.7%)
Don't know	2 (0.7%)	0	0

and one French student said that they did not do any independent research or were not asked to carry out this task.

The interview data corroborated the questionnaire results in terms of the various sources of information consulted. In the interviews the students frequently mentioned using the internet. However, a wide variety of usage from the very general to the specific was reported. For example:

*I'd just Google it! And probably go on, like a bite size website or something like that. Wikipedia's always good as well. (Economics student)*

*The internet.... I've found the BBC website very useful for Economics – its business section. (Economics student)*

When asked if the students used books to gather information while carrying out independent research, one student said:

*Not really... we don't use books, we find the internet is an easier resource to use. (Economics student)*

One student explained why he sought information from a relative:

*I sometimes ask my cousin stuff. My older cousin, depending on what it is really. If it's more political-based, I'll just speak to my cousin about it, sometimes if I don't fully understand stuff, because he's like got a 2.1 from Cambridge in law and thinks he's God's gift. But he's (useful) sometimes. (Economics student)*

In the interviews, the students were asked to define independent study skills. The following examples illustrate the variety in students' understanding of independent study:

*Being able to find out information on your own but if you are struggling you should be able to ask someone else who should be able to, but not be dependant on them. Going to people and saying can you help me. (Economics student)*

*Just being able to work out what you need to do and to find useful information for exams. (French student)*

*I would say just to understand how to be in charge with your own learning. (French student)*

*The ability to ask further questions, gaining more knowledge further depth on a subject of your own accord, so that you deepen your understanding of a topic. (French student)*

## Discussion

In this study, the frequency with which Mathematics, Economics, and French teachers set independent research tasks for their students was explored. Teachers' opinions about the extent to which they thought their particular course developed students' independent research skills were also explored. Additionally, the frequency with which Mathematics, Economics, and French students thought they carried out independent research was investigated, as were the resources they consulted while doing so. Cross-subject comparisons were made.

### Limitations

The study has certain limitations that are commonly associated with self-reported data. The primary weaknesses of a survey method include: multiple interpretations of the same question; limited/incomplete recall

of information; and responding to the questions based on certain preconceived expectations (Cohen *et al.* 2000). In order to corroborate the questionnaire results, a number of face-to-face interviews were conducted with teachers and students. However, the interview sample was small and may not have been representative of the sample that responded to the questionnaire. The other main limitation of this study is that it explored the development of independent research in courses offered by a single awarding body. Therefore, the sample in this study may not be representative of teachers and students of other A level courses and awarding bodies. Finally, this study is based on a small section of a wider project on teaching and learning at A level. Therefore, resources were insufficient for it to explore all the various aspects in relation to independent research.

### Summary of main findings

A significant quantity of data was collected. A total of 47 Mathematics teachers, 24 Economics teachers and 15 French teachers responded to the teachers' survey. Additionally, 299 Mathematics students, 228 Economics students and 136 French students responded to the students' survey. In terms of performance in examinations, economic deprivation, and the centre type of the responding schools/colleges, the sample was sufficiently representative of the full population.

With regard to the frequency with which teachers set investigation/research tasks for their students in the classroom context, it was found that about half of the French and Economics teachers were assigning such tasks to their students from once a week to once a fortnight. On the other hand, about half of the Mathematics teachers were setting such tasks less often and about 40% of them never set investigation/research tasks. The frequency with which the teachers set investigation/research tasks as homework/private study showed the same subject-specific differences as the classroom context.

It was found that the majority of the French teachers felt that their course offered some opportunity to develop independent research skills. More than half of the Economics teachers also held the same view of their course. However, Mathematics teachers differed in that more than half of them felt that much of their course did not require an independent approach on the part of the students. The majority of the French teachers agreed with the statement that their course enabled students to develop research and investigative skills that are useful in higher education. A little less than 50% of the Economics teachers agreed with the same view, followed by only 13% of the Mathematics teachers.

This article also explored the extent to which students thought they conducted independent research. Reassuringly for the validity of the data, the same subject-specific differences emerged among the students' responses as among the teachers' responses. More French and Economics students in comparison to the Mathematics students stated that they carried out investigation/research both in class and at home. These subject-specific differences might be the result of actual difference in practice, or could be due to differences in the respondents' understanding of the survey questions.

The internet was the most frequently listed source that students across all three subjects consulted while engaging in independent research. The interview data shed further light on the general and specific usage of the internet. The survey data indicated a few subject-specific differences in the resources used for independent research. For instance, magazines and newspapers were listed by a few Economics and French students, but were not used by Mathematics students.

### Conclusions and further research

To conclude, the findings from this study shed some light on the variation in preparedness of 16 to 18 year old students for independent study and research-related tasks at university. This study could help teachers to reflect upon their teaching and learning practice, and to identify whether there is scope or need for independent study and research in the A level courses they teach, and how this might be incorporated within their teaching and assessment strategies. Porkess *et al.* (2011) suggest that Mathematics teaching requires better implementation of the syllabus. This might involve getting students to think further and more in depth, for instance, through independent research. Suto *et al.* (2011) have found that significantly more teachers teaching in schools with relatively high A level Mathematics results than with relatively low results believe teaching beyond the syllabus strengthens and expands students' existing knowledge and adds interest to the course. Further work in this area with larger samples could also explore the relationship between independent research and school performance.

This study forms a small section of a wider project on teaching and learning at A level. It would be useful to carry out further research focussing exclusively on independent research; exploring, for instance, teachers' views of the effectiveness of independent research at A level, particularly when carried out at home. One Mathematics teacher and two Economics teachers claimed that their courses fostered independent research throughout their entirety. Further work could be carried out with these teachers to understand the elements of the course and their teaching that facilitate development of independent research. The interview data with teachers indicated that independent research skills were being developed in a variety of school contexts. Therefore, further work on independent research and study could be explored within a wider school context. This study included A level courses from only one awarding body; it could be replicated with courses administered by different awarding bodies to determine if the same trends emerge as in this study.

Some interesting differences emerged in the frequency of independent research reported by the Mathematics teachers and their students. Future work exploring students' and teachers' understanding and their definitions of independent research, investigation, and related terms might shed further light on such differences in self-reported data. While this study indicates that teachers across three very different subjects provided opportunity for independent research, additional work needs to be carried out to understand the practical challenges of facilitating independent research/study. If it were found that more teachers would like their students to participate in independent research, but that the syllabus or focus of the assessment objectives prevents them from engaging their students with this task, then the qualification developers would need to determine how this could be addressed.

An issue related to the effectiveness of independent research is the ability of the teachers to facilitate it. Although some teachers might be extremely competent in delivering the content of their subject, they might be less able to supervise and guide their students' research activities. This problem may be exaggerated in cases where non-specialists are responsible for teaching a particular subject. While this study gathered data about how often teachers were assigning independent research tasks to their students and whether they felt that their courses facilitated this aspect, the study information on the nature of those independent research tasks was not obtained. Additional work that looks at the strengths and limitations of independent research that is embedded in staple courses such as A levels, relative to dedicated research routes such as EPQ, would also be worthwhile.

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