“Visions of the Future “, Horizon Report

Public Deliverable – D3.2

Deliverable Coordinator: Dai Griffiths

Coordinating Institutions: University of Bolton, The Open University, UK

Date due: 31 December 2015 (+ five weeks extension)

Keywords: LACE, visions, future, 2025, desirability, feasibility, action

Abstract:
This document reports on a Policy Delphi study focused on the state of learning analytics in 2025. The study centred on eight visions of the future, which were rated and commented on by experts in terms of their desirability, feasibility and requirements for action.
Highlights

This report describes the Visions of the Future of Learning Analytics study carried out by the LACE project. Eight visions of the future of learning analytics were developed by the LACE project, and these were the basis of consultations with the learning analytics community. The principal instrument used was a SurveyMonkey survey, including both Likert scale and free text responses. The survey attracted 103 responses from invited experts and LACE contacts. Consultations with stakeholders have also been carried out in face to face meetings.

The results were analysed in three ways:

1. Charts of the Likert scale scores
2. Analysis of the individual visions in the light of the Likert scores and the free text comments provided by respondents
3. Thematic analysis of the corpus of free text comments from all visions.

Highlights of the findings include:

1. There is a lot of enthusiasm for Learning Analytics, but concern that its potential will not be fulfilled
2. Policies and infrastructure are necessary to strengthen the rights of the data subject. Interoperability specifications and open infrastructures are an enabling technology.
3. Learning analytics should not imply automation of teaching and learning.
4. Issues of social and political power, ethics, and ownership are central factors to the future of learning analytics
5. There is some disagreement between educational sectors, raising the possibility should be considered that a socio-technical elite is proposing systems and methods that are not entirely welcomed by practitioners in the field.
6. The necessary underlying technology is already available, and will continue to develop.

Reading guide

The purpose and design of the study is described in Section 1.

The detailed results are discussed in sections 2 & 3, and additional charts are provided in appendix 1. The analysis has been kept as concise as possible, but inevitably these sections include a considerable amount of detail. Some readers may wish to skim or skip these sections on a first reading, and move straight to Section 4, Conclusions.

The Conclusions section summarises the findings of sections 2 & 3, contrasts them, and considers their implications. The sections makes frequent reference to the detailed analysis, and interested readers can refer back to specific sections referenced.
1. Introduction ........................................................................................................................................ 4
   1.1. The need to understand where current trends are leading ......................................................... 4
   1.2. Methodology ................................................................................................................................. 4
   1.3. The work carried out .................................................................................................................... 6
2. Discussion of the Likert scale results, related to free text responses ............................................. 10
   2.1. Vision 1: In 2025, classrooms monitor the physical environment to support learning and teaching ........................................................................................................................................ 11
   2.2. Vision 2: In 2025, personal data tracking supports learning ...................................................... 13
   2.3. Vision 3: In 2025, analytics are rarely used in education ............................................................... 15
   2.4. Vision 4: In 2025, individuals control their own data ....................................................................... 17
   2.5. Vision 5: In 2025, open systems for learning analytics are widely adopted ............................... 19
   2.6. Vision 6: In 2025, learning analytics systems are essential tools of educational management ...... 21
   2.7. Vision 7: In 2025, most teaching is delegated to computers ......................................................... 23
   2.8. Vision 8: In 2015, analytics support self-directed learning ......................................................... 25
3. Themes that emerged from the data .................................................................................................... 27
   3.1. Theme: Affect .................................................................................................................................. 28
   3.2. Theme: Alienation .......................................................................................................................... 28
   3.3. Theme: Complexity ....................................................................................................................... 30
   3.4. Theme: Cost ................................................................................................................................... 31
   3.5. Theme: Ethics ............................................................................................................................... 32
   3.6. Theme: Experience ....................................................................................................................... 32
   3.7. Theme: Pedagogy .......................................................................................................................... 34
   3.8. Theme: Power ................................................................................................................................ 35
   3.9. Theme: Privacy ............................................................................................................................. 36
   3.10. Theme: Regulation ......................................................................................................................... 37
   3.11. Theme: Standards ......................................................................................................................... 38
   3.12. Theme: Temporality ...................................................................................................................... 39
   3.13. Theme: Validity ............................................................................................................................ 40
4. Conclusions ........................................................................................................................................ 42
   4.1. Differing judgements on desirability and feasibility ................................................................. 42
   4.2. Judgements on the eight visions, and their implications ............................................................. 43
   4.3. The range of themes informing the judgements on the visions ................................................... 46
   4.4. Overall findings ............................................................................................................................ 47
5. Future Steps .................................................................................................................. 52
Reference list ...................................................................................................................... 53
Appendices .......................................................................................................................... 54
  Appendix 1. Graphical representation of the Likert scale results ........................................ 54
  Appendix 2: Coding summary chart .................................................................................... 60
  Appendix 3: Visions of the Future ...................................................................................... 61
  Appendix 4: Information for participants ........................................................................... 63
About .................................................................................................................................. 65

List of figures
Figure 1: Vision 1 desirability and feasibility ........................................................................ 11
Figure 2: Vision 2 desirability and feasibility ........................................................................ 13
Figure 3: Vision 3 desirability and feasibility ........................................................................ 15
Figure 4: Vision 4 desirability and feasibility ........................................................................ 17
Figure 5: Vision 5 desirability and feasibility ........................................................................ 19
Figure 6: Vision 6 desirability and feasibility ........................................................................ 21
Figure 7: Vision 7 desirability and feasibility ........................................................................ 23
Figure 8: Vision 2 desirability and feasibility ........................................................................ 25
Figure 9: Disparity in attitudes to desirability and feasibility .................................................. 42
Figure 10: Respondents knowledge of learning analytics ....................................................... 54
Figure 11: Respondents by sector ......................................................................................... 54
Figure 12: All desirability data ............................................................................................... 55
Figure 13: All feasibility data ................................................................................................. 55
Figure 14: Desirability data charted by sector ....................................................................... 56
Figure 15: Feasibility data charted by sector ......................................................................... 57
Figure 16: Desirability data charted by respondents (responded to direct/general) invitation ..... 58
Figure 17: Feasibility data charted by respondents (responded to direct/general) invitation ..... 59

List of tables
Table 1: Overview of the visions (see Appendix 1: Visions of the Future for the text in full) ........ 6
Table 2: Themes that emerged from the data ......................................................................... 27
Table 3: Summary table of the application of codes, with key words ...................................... 46
Table 4: Number of applications of codes in the 8 visions .................................................... 60
1. Introduction

1.1. The need to understand where current trends are leading

The LAK15 conference in Poughkeepsie ended with a panel that considered the current state of the field. Four international experts – from Europe, North America and Australasia – discussed the current position of learning analytics and future possibilities.

Simon Buckingham Shum noted that the LAK community must move on from building analytics for the schools and university of 2015 and start to design the fabric of analytics in 2025.

The future of learning analytics depends to a large extent on the policy adopted by institutions and governments. Its practice will be greatly shaped by the regulatory framework which is established, the investment decisions made, the infrastructure and specifications which are promoted, and the educational discourse. (Buckingham Shum 2015)

This is no small challenge, in part because the technology with which we work is changing so fast. “Typically, we find that the doubling time for different measures – price-performance, bandwidth, capacity – of the capability of information technology is about one year” (Kurzweil 2005, p.4)

Communities are becoming more connected, pedagogies are changing, and educators are looking for new ways to engage students. Some already believe that ‘existing solutions don’t address the most urgent needs in education’ (US Department of Education Office of Educational Technology 2015, p.6). The fast pace of change means that if, in April 2006, we had begun developing learning analytics for 2016, we might not have planned specifically for learning with and through social networks (Twitter was launched in July 2006), with smartphones (the first iPhone was released in 2007), or learning at scale (the term MOOC was coined in 2008). However, by consulting with experts, we might have come pretty close by taking into account existing work on networked learning (Goodyear et al. 2004), mobile learning (Sharples 2000) and connectivism (Siemens 2005).

It is important that the learning analytics community looks to the future, because the future of the field will depend to a large extent, as Buckingham Shum noted, on policies adopted by external bodies. Its practice will be moulded by regulatory frameworks that are established externally, the investment decisions made by others, the infrastructure and specifications that are promoted across the world, and the educational discourse that is employed. By developing a clear view of what is desirable and feasible in the future – and what we need to avoid – we can equip ourselves to make policy recommendations, to advise funders, and to take a leading role in shaping the frameworks, the infrastructure, the specifications and the discourse with which we shall be working.

To meet this need understand what is desirable and feasible, the LACE project has undertaken a Policy Delphi. As stated in the DOW (p.12), this work seeks to “draw out differences of perception and vision from a group of researcher and practitioner experts drawn from our liaison organisations and from people who have participated in our activities. This will consider views on what is desirable, what is feasible and the obstacles to making what is desirable happen.”

1.2. Methodology

1.2.1. What is a ‘Policy Delphi’

The origins of the Delphi method are described by the Rand Corporation:
RAND developed the Delphi method in the 1950s, originally to forecast the impact of technology on warfare. The method entails a group of experts who anonymously reply to questionnaires and subsequently receive feedback in the form of a statistical representation of the “group response,” after which the process repeats itself. The goal is to reduce the range of responses and arrive at something closer to expert consensus. (RAND Corporation n.d.).

Further details are available in (Helmer-Hirschberg 1967). The underlying assumptions of the Delphi method are that group judgements are more valid than individual judgements, and that a series of coordinated activities can uncover a group judgement. This method, with incremental changes and additions, is still applied to achieve consensus. However, a major offshoot of the method was instigated by Turoff in the 1970s. As Turof explains:

Delphi as it originally was introduced and practiced tended to deal with technical topics and seek a consensus among homogeneous groups of experts. The Policy Delphi, on the other hand, seeks to generate the strongest possible opposing views on the potential resolutions of a major policy issue. (Turoff & Linstone 2002, p.80)

Turoff goes on to argue that when confronted by a question of policy, rather than of prediction, analysis and research “can do no more than supply a factual basis for advocacy.” The future will depend on policy decisions, and Turoff argues, “the decision maker is not interested in having a group generate his decision; but rather, have an informed group present all the options and supporting evidence for his consideration” (Turoff & Linstone 2002, p.80)

The future of learning analytics depends to a large extent on the policy adopted by institutions and governments. Its practice will be greatly shaped by the regulatory framework which is established, the investment decisions made, the infrastructure and specifications which are promoted, and the educational discourse. Consequently, following the DOW, the LACE project is conducting a policy Delphi, rather than a consensus Delphi.

Consequently, the LACE Policy Delphi does not seek consensus, but rather to understand diverse views of the preferred future, with the members and associates of the LACE project fulfilling the role of the ‘informed group’.

1.2.2. Aims and objectives
Adapting the definition of a Policy Delphi in (Turoff 1970) we define our intervention as follows:

**Aim:** the systematic solicitation and collation of informed judgments on learning analytics

**Objectives:**

- To explore or expose underlying assumptions or information leading to differing judgments on learning analytics
- To correlate informed judgments on the topic of learning analytics, which spans a wide range of disciplines.

**Future addressed:** The date in the future which our visions relate to is 2025, which coincides with the EU tender recently passed: 2025-2030.

1.2.3. The design of the Policy Delphi
The design of the LACE Policy Delphi is as follows.
1. The first phase of the Policy Delphi draws on the expertise of LACE consortium members to develop visions of learning analytics in 2025 in the form of short scenarios. Following a matrix analysis, these visions are selected to provide good coverage for (a) relevance to stakeholders, and (b) the underlying themes of technology, privacy and ethics, and pedagogy.

2. The second phase involves an online survey of designated experts, and volunteers who responded to the focused publicity generated by LACE. The experts are drawn from the three focus domains of application of LACE (schools, higher education, and the workplace) and the three principal contributing discourses of learning analytics (technology, privacy and ethics, pedagogy).

3. The third phase focuses on input from stakeholders. Following analysis of earlier results, the scenarios with their desirability and feasibility ratings are shared with stakeholders, who added their responses. The results of this phase fed into an analysis of what is feasible and desirable, and of what would need to change to make any of these visions a reality.

4. The final phase is strategic analysis of findings. This is designed to clarify any disagreements between experts and the stakeholders, and to identify gaps between current infrastructure and practice and those that will be required for the future. It will also identify the drivers which are implied by the responses to the visions. The present report presents these findings.

1.3. The work carried out

1.3.1. Development of the visions

The expertise within the project was mobilised to identify a range visions which reflected the wide variety of opinions about how learning analytics will develop. Following a matrix analysis, these visions were cut down in number, following two criteria: (a) to identify themes which would be relevant to the range of expert stakeholders who were our target population, and (b) to include a good coverage of the underlying areas of technology, privacy and ethics, and pedagogy which have emerged as key themes in the LACE project. The titles are given in the following table, and the full texts of the final visions are provided in Appendix 1.

Table 1: Overview of the visions (see Appendix 1: Visions of the Future for the text in full)

<table>
<thead>
<tr>
<th>No.</th>
<th>Vision title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In 2025, classrooms monitor the physical environment to support learning and teaching</td>
</tr>
<tr>
<td>2</td>
<td>In 2025, personal data tracking supports learning</td>
</tr>
<tr>
<td>3</td>
<td>In 2025, analytics are rarely used in education</td>
</tr>
<tr>
<td>4</td>
<td>In 2025, individuals control their own data</td>
</tr>
<tr>
<td>5</td>
<td>In 2025, open systems for learning analytics are widely adopted</td>
</tr>
<tr>
<td>6</td>
<td>In 2025, learning analytics systems are essential tools of educational management</td>
</tr>
<tr>
<td>7</td>
<td>In 2025, most teaching is delegated to computers</td>
</tr>
<tr>
<td>8</td>
<td>In 2025, analytics support self-directed autonomous learning</td>
</tr>
</tbody>
</table>
The visions were also substantially reduced in length, to make it easier for respondents to engage with the process. The visions which were selected were cutting edge but also not far-fetched. The eight scenarios that were developed in this process formed the basis for all subsequent phases.

1.3.2. Development of an online survey
An online survey was designed using SurveyMonkey. It was considered that it would be too great a burden to ask respondents to read and comment on all eight visions. It was therefore decided to present the visions to the experts in random order. After each vision the respondent was asked if they were willing to answer another. It was requested that each respondent should address at least three visions.

The respondents were asked two questions about themselves:

1) How well informed are you about learning analytics in terms of
   • Learning technology
   • Analytics and machine learning
   • Ethical issues
   • Pedagogy and professional practice

2) Which sectors of education have you worked in? Please tick all that apply.
   • Schools
   • Workplace
   • Higher Education

Respondents were then asked to assess each vision in terms of its feasibility, its desirability, and the steps which would be required in order to make it a reality. Standard questions were asked for each vision:

Likert scale: How desirable is this vision? Please give your answer on a scale from (1) to (4)

Likert scale: How feasible is this vision? Please give your answer on a scale from (1) to (4)

(Participants were given the option of selecting ‘I do not feel qualified to respond’ instead of rating desirability or feasibility).

Free text: In the light of the score you have given for desirable - - - - undesirable, what actions do you think should be taken? For example there may be legal, policy, technical or other developments which you think are needed to make this vision a reality, or to prevent it happening. Please describe the initiatives which are necessary, and who should take them.

Respondents were also invited to make free text comments on their Likert scale responses.

1.3.3. Information provided to participants
Participants were given a full explanation of the purpose of the study and how their data would be used before commencing the study. This text is available in Appendix 4: Information for participants. Respondents were also offered the opportunity to state that they did not want their free text input to be quoted.
1.3.4. Population
The population of respondents was drawn from two groups. Firstly experts were designated by the LACE work-packages dealing with Schools, Workplace and Higher Education, paying attention to the three principal contributing discourses of learning analytics in LACE (technology, privacy and ethics, pedagogy). The LACE Associate Partners were all included in this expert group. Secondly volunteers were solicited in publicity generated on the LACE website and the LACE newsletter. A total of 193 designated experts were sent emails with direct links to the survey, which enabled the team to keep track of the proportion of responses which were made by invited experts, and to contrast their input.

1.3.5. Response
In total 133 people started the process of answering the questionnaire. Of these 103 responded to at least one vision. The number of complete responses to visions was 487, an average of 3.6 per respondent (compared with the requested 3.0 per respondent).

1.3.6. Consultation with stakeholders
Direct consultation with stakeholders has already taken place at a number of events.

• Solar Flare, Open University of the UK,
• Institutional Readiness Day for Learning Analytics Technologies
• Onderwijsdagen Education Days, Rotterdam, Netherlands.
• BETT, London UK

1.3.7. Analysis
The data was downloaded from SurveyMonkey as Comma Separated Values, and analysed using a spreadsheet. Those respondents who did not want to be quoted were highlighted.

The intention of the analysis was not to use the data to determine an order of likelihood for the 8 visions, but rather to identify the drivers, issues and concerns which experts believe will condition the future efficacy of learning analytics. Because of this a statistical approach was not appropriate.

The results of the Likert data were used to generate charts indicating the degree of desirability and feasibility ascribed to the visions. These were subdivided by three sectors (School, Workplace, and Higher Education), and by source of respondent (invited expert, through the web link), and the resulting charts are available in Appendix 1. The team then examined the charts to identify the broad attitudes of the respondents towards the visions, and to highlight any contrasts between different subdivisions of respondents, or between the responses to different visions.

The Likert charts for each vision were then contrasted with free text responses to that vision, in order to achieve a more nuanced view of respondents’ attitudes.

In order to achieve a more global understanding of the respondents’ views of the issues driving the development of learning analytics, the data for all eight visions was cumulated, and the free text entries were coded according to thirteen themes. These themes were developed by four researchers in a day-long working session. They first collaborated in the coding of the free text responses for ‘desirability’, ‘feasibility’ and ‘necessary actions’ for a single vision, then reviewed the resulting codes and merging them where appropriate, and finally individually coded the remaining data while
conferring on any doubts which they encountered. The coding was non-exclusive, i.e. each text could be assigned more than one code. The texts associated with each code were then compiled, and distributed to the researchers, who were individually assigned the task of summarising a number of themes. The results of this process are available in Section 3.
2. Discussion of the Likert scale results, related to free text responses

In this section we briefly discuss the personal information provided by the respondents. We then contrast the Likert scale results for each vision, and interpret them with reference to the free text responses provided for that vision.

The Visions of the Future study was directed at experts, and so we should not be surprised to find that the respondents in general assessed the degree to which they are ‘well informed about learning analytics’ as being high. The reported knowledge of ‘analytics and machine learning’ was lower than for any other category, although even in this case a majority still considered themselves ‘well informed’ or ‘very well informed’. This suggests that many of those working with learning analytics do not have a strong working knowledge of the underlying methods which are being used. Learning analytics is a field which brings together educationalists and technologists (Suthers & Verbert 2013), and it is to be expected that educationalists find some aspects of the work of the technologists to be opaque.

The great majority of respondents had experience of higher education. Note that the total of responses is greater than 100% because respondents were able to claim experience of more than one sector. This suggests that many respondents have moved to higher education from schools or the workplace (or vice-versa). The much higher score for higher education reflects the dominance of the sector in the development of learning analytics systems, and in the production of research on the design and use of learning analytics systems.
2.1. Vision 1: In 2025, classrooms monitor the physical environment to support learning and teaching

2.1.1. Text of vision 1

In 2025, classrooms monitor the physical environment to support learning and teaching.

In 2015, learning analytics were mainly used to support online learning. By 2025, they can be used to support most teaching and learning activities, wherever these take place. Furniture, pens, writing pads – almost any tool used during learning – can be fitted with sensors. These can record many sorts of information, including tilt, force and position. Video cameras using facial recognition are able to track individuals as they learn. These cameras monitor movements, and record exactly how learners work with and manipulate objects. All this information is used to monitor learners’ progress. Individuals are supported in learning a wide range of physical skills. Teachers are alerted to signs of individual learner’s boredom, confusion, and deviation from task. Teachers and managers are able to monitor social interactions, and to identify where they should nurture socialisation and cooperative behaviour.

2.1.2. Likert scale results

The Likert scale results for this vision show that a majority of respondents found it to be undesirable, and that over twice as many found it to be ‘very undesirable’ than found it ‘very desirable’. As regards feasibility, however, a majority of respondents described the vision as being feasible or very feasible. This suggests a concern that the availability of technology may lead the education system into making changes which are not pedagogically appropriate.

This vision is clearly aimed at the school classroom, and the results show that respondents from schools were substantially more positive in their assessment of the vision than were those from higher education or the workplace.
Respondents to the web link were on balance against the vision, and almost twice as many respondents to the web link found the vision to be ‘very undesirable’ than did invited experts, raising the possibility that there may be a gap in understanding between experts and practitioners on the ground.

2.1.3. Free text responses
Free text comments on the desirability of this vision focused on two areas: the efficacy of the pedagogic intervention, and the social and ethical consequences. 23 comments were negative, 11 ambivalent, and only 9 favourable, suggesting that it was mainly those who found the vision ‘very undesirable’ that were motivated to comment. The strength of their comments also suggests that they might be willing to actively resist the implementation of such systems. Negative comments included “very intrusive”, “just ridiculous”, “Big Brother scenario”, “loss of humanity”, “The real fuel of Learning is motivation and volition, which you cannot capture with external sensors”, etc.

Some respondents believed that the state of the art in pervasive computing show that this vision is feasible, and that developments related to the Internet of Things and Quantified Self movements will drive prices down so by 2025 making this vision very likely to occur. Other respondents were of the opinion that although the technology for gathering the necessary data could be available by 2025, there is doubt as to whether data processing algorithms which can produce valid and reliable conclusions relevant to education will be delivered by 2015. Concerns were raised about the cost to institutions and organisations of equipping classrooms with the necessary technology, and the capacity and capability of teachers to digest and react to the data, meaning this approach would be difficult to implement at scale. Questions relating to peoples’ attitudes to being closely monitored were raised, e.g. how would this approach work if some learners (or parents) or teachers were able to refuse to have their data collected? More generally, it may be human factors, rules and regulations that could affect the timescale and ease of implementation of this vision.

As regards the actions that need to be taken, respondents generally indicated that the required underlying technology was either already available or would soon become so. Required actions related to the two principal concerns expressed in desirability. Firstly many comments indicated that research is needed to demonstrate if and how this approach to learning and teaching is effective. Secondly, many comments requested protocols, regulations or legislation to govern ethics and privacy.

2.1.4. Key words
Commercial pressure, efficacy, ethics privacy, funding, pedagogic, policy, reliability, scalability, validity.
2.2. Vision 2: In 2025, personal data tracking supports learning

2.2.1. Text of vision 2

In 2025, personal data tracking supports learning

In 2015, people were beginning to wear devices such as heart-rate monitors and run-trackers as they went about their daily lives. By 2025, sophisticated sensors can gather personal information about factors such as posture, attention, rest, stress, blood sugar, and metabolic rate. People collect this information about their activities, and feed it into programmes of their choice that provide recommendations on how to act in ways that improve their learning. Learners can download the statistics and data that are associated with successful learning in a certain area. Aligning personal data with these 'ideal' sets is claimed to help people to master skills as diverse as swimming, driving, carrying out surgery and passing examinations. Academic stars sell programmes using this data to optimise learning for different ages and courses. Business gurus market similar programmes for topics such as presentation skills and workload management. Some learners create and share their own data analysis programmes, which provide recommendations that often include the consumption of high-energy foods and stimulants. The majority of high-school and university students follow self-monitoring programmes, and discuss the merits of these on social media.

2.2.2. Likert scale results

<table>
<thead>
<tr>
<th>Vision 2: desirability</th>
<th>Vision 2: feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not desirable</td>
<td>Not feasible</td>
</tr>
<tr>
<td>24%</td>
<td>0%</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>26%</td>
<td>20%</td>
</tr>
<tr>
<td>26%</td>
<td>30%</td>
</tr>
<tr>
<td>Very desirable</td>
<td>Very feasible</td>
</tr>
<tr>
<td>19%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Figure 2: Vision 2 desirability and feasibility

The pattern of results for Vision 2 is similar to that for Vision 1: the vision is considered to be feasible, but respondents are ambivalent about its desirability, with a slight majority finding it to be undesirable. The responses from the three sectors are broadly similar, as are the responses from invited experts and web link respondents.

2.2.3. Free text responses

The free text responses also echoed the comments made on Vision 1, with a focus on the efficacy of the pedagogic intervention, and the social and ethical consequences. The number of free text responses was slightly lower, with 5 positive comments, 11 ambivalent, and 18 negative. Given that
privacy is a major concern in both visions, it is coherent to suggest that data gathering by the individual was seen as more acceptable than data gathering by the institution, and that this made the response milder. Indeed one comment explicitly stated “I am neutral on this, but warm to it much more than #1 because users appear to have control over the monitoring and use of the data”. However, one user commented that “the vision fails to mention who owns the data”, while others mentioned the potential misuse of data. Others were concerned at the “loss of free will”, and that “sounds like we are robots controlled by our algorithmic overlords.

The positive comments on desirability mostly mentioned the pedagogic benefits which could be gained, with mention, for example, of achieving personalised learning, and “improving the success and impact of learning”. These were balanced by a larger number of negative comments, for example referring to “snake oil”, and the undesirability of substituting physical for conative indicators. There were a larger number of comments which took a nuanced view of desirability, when compared with Vision 1. These recognised the potential of monitoring personal performance, but raised concerns about the interpretation of the data, or its ethical use.

Some respondents said that personal data tracking initiatives are currently running, but on a single measure, and not combined with other measures into such a big visionary concept, and that the availability of products using one or more measures is likely by 2025. Others felt that although technology capable of acquiring the data described is likely to be available in 2025, doubts about being able to use this data optimise learning were raised. There were concerns that personal data tracking as described in the vision would have limited effect, because it ignores constraints on learning which may have more impact: pressures of work, family, social life; lack of intrinsic motivation; making curricula sufficiently relevant to people's lives, and other factors which draw individuals’ attention away from their learning. Other concerns included the development and successful marketing of products akin to those in the vision, but based on poor research and spurious statistics, resulting in negative feedback when marketing claims are not matched by real changes in performance.

The actions required to make the vision a reality were also similar to those for Vision 1. No mention was made of a need to develop the underlying technology. Research into the pedagogic potential of these methods was requested in order to create a stronger evidence base. The need to regulate data management, and privacy policies, were also mentioned.

2.2.4. Key words
Ethics, learning outcomes, motivation, pedagogy, personalisation, privacy, profit, reliability.
2.3. Vision 3: In 2025, analytics are rarely used in education

2.3.1. Text of vision 3

In 2025, analytics are rarely used in education

In 2015, many people hoped that analytics would be able to improve teaching and learning and the environments where these take place. However, in 2025, it is clear that there are many problems. Courses that are automated by analytics are seen as inferior, and learners have realised that they can game the system. There have been major leaks of sensitive personal data, and it is clear that, even where this has not happened, many companies have misused the data generated by their analytics. Many governments have ruled that individuals are the sole owners of the data they generate. All use of data for educational purposes now has to be approved not only by the learner but also by new inspectorates. In practice this has meant that use of analytics is restricted to summative assessment carried out by government agencies. A consensus has emerged in educational policy: the move away from learning analytics is not only ethically desirable it is also educationally effective.

2.3.2. Likert scale results

The Likert scale results show that a large majority of respondents viewed the idea that learning analytics would be rarely used in 2025 as extremely undesirable, with only 1 person viewing it as desirable (and in this case the rating was qualified by a free text comment stating that the rating assumed that ‘learning analytics had become corrupt or untrustworthy’). On the other hand this highly undesirable outcome was seen by many as being feasible, with a slight majority viewing it as being feasible or very feasible.

2.3.3. Free text responses

In their free text responses on desirability, respondents made clear their support for analytics making comments such as “Educators have always collected and used ‘data’”, “Don’t throw away the entire field because of some mistakes and errors!” and “I think it is madness to have lots of data
and not use it”. Some respondents took the opportunity to explain that their support for learning analytics was conditional, with statements such as “My ideal scenario is where human teachers use learning analytics ethically and professionally to enhance learning design and understand learning”, and “The cases of misuse of data are possible, but the risks are minimal compared to the potential of better student personalization.”

Some thought this vision is not feasible because learning analytics are already influencing and improving education practice and policy in a positive way. Also, in several other fields analytics is used successfully (e.g. professional sports), and lessons can be learned from how it has become implemented and embedded into practice. Others thought it unlikely as institutions have collected and managed sensitive data about their learners for many years without disasters occurring, and there are no signs that the risk of leaks has risen, or that there has been a great increase in the sensitivity of the data. Some respondents opined that although the vision may occur in some contexts in which learning analytics is implemented ‘badly’ or where ethical or legal concerns impinge on learning analytics being used, it is unlikely to happen globally. In some cases the reaction of the popular media may be very influential.

The actions recommended by respondents in their free text comments focused on two principal areas. Firstly, policy for data privacy and appropriate use, with many requests for more effective regulation (although one respondent argued that in a free market no action was required). Four comments made the cogent point that to be effective, policies have to be implemented in the systems and tools used in learning analytics, and that this implies the need for standards with teeth. Given the low number of respondents with deep technical knowledge of learning analytics, it may be argued that more attention should be placed on this point than the relatively small number of comments suggests. Secondly, respondents asserted the need to generate and demonstrate pedagogic benefits. Some mentioned the need to focus on student centred education, and the presence of humans in the analytics process.

2.3.4. Keywords
Commercial interests, ethics, government control of data, infrastructure, pedagogic benefits, policy, privacy, regulation, user control.
2.4. Vision 4: In 2025, individuals control their own data

2.4.1. Text of vision 4

In 2025, individuals control their own data

In 2015, it was not clear who owned educational data, and it was often used without learners’ knowledge. By 2025, most people are aware of the importance and value of their data. Learners control the type and quantity of personal data that they share, and with whom they share it. This includes information about progress, attendance and exam results, as well as data collected by cameras and sensors. Learners can choose to limit the time for which access is allowed, or they can restrict access to specific organisations and individuals. The tools for making these choices are clearly laid out and easy to use. In the case of children, data decisions are made in consultation with parents or carers. If they do not engage with these tools, then no data is shared and no benefits gained. Most educational institutions recognise this as a potential problem, and run campaigns to raise awareness of the both the risks of thoughtless exposure of data, and the benefits to learners of informed sharing of selected educational data.

2.4.2. Likert scale results

The Likert scale results for Vision 4 show very strong support for the idea that learners should be able to control their own data, with a majority of respondents rating this as ‘very desirable’. The respondents also indicated that this vision was feasible, although the result was less clear than for ‘desirability’ (nearly 50% rated this as a ‘3’, rather than a ‘4: very feasible’). The results for all three sectors were similar, although schools respondents were a little more optimistic about the feasibility, while workplace respondents were a little less. The results for the invited experts and those who accessed the web link were similar.

2.4.3. Free text responses

The free text responses on desirability reflect the strong Likert scale scores in favour of this vision. They almost all stress the importance of individuals having greater control over the data that they
generate. There are a few dissenting voices. Three respondents were concerned that the vision would prevent learning analytics from fulfilling its potential, as one said it “Greatly limits our ability to effectively use learning analytics to improve learning for ALL students”. In this they are echoing the position taken by the codes of practice for learning analytics published by Jisc (Sclater 2014) and OUUK (The Open University 2014), which use this argument in favour of the institution making use of all educational data, without explicit permission from students.

Although many types of data will be routinely captured, feasibility of this is based on overcoming significant social and political hurdles. Although it is feasible technically there will be many parties with conflicting interests that will lobby against full user control of data, e.g. commercial and government interests. Changes in policy and law will be necessary, and it will be impossible to achieve harmonised legislation due to the effect of different legislative regions. Furthermore, some thought it unlikely that governments or organisations would relinquish their control over learner data and maintain some rights to data as part of the conditions of using their services. Some thought that education and awareness is key to this vision, in that the user population need a better understanding of the value of personal data for their own benefit as well as that of organisations, and to be actively engaged with privacy and data control issues.

In terms of the actions which are necessary, most comments affirmed the need for rules and policies about the management of personal data. A number of comments expressed the concern that commercial pressure would make the vision impossible, for example “I doubt though, that it is so feasible. There will always be people/companies/etc. trying to make use of other people's data for commercial reasons”. A few comments asserted the need for data security standards and privacy standards, and the tools which could make this a reality. One of the respondents who was concerned about this vision preventing learning analytics from achieving its potential suggested that institutions should “Make policies about USE not collection. With clear, consistent & transparent policies about use, people will not be as concerned about collection.”

2.4.4. Keywords
Commercial pressures, government control, legislation, pedagogic benefits, privacy, regulation, user control.
2.5. Vision 5: In 2025, open systems for learning analytics are widely adopted

2.5.1. Text of vision 5

In 2025, open systems for learning analytics are widely adopted

In 2015, companies produced a range of learning analytics tools, using different approaches and standards. The algorithms and models that companies use are often protected as intellectual property. By 2025, the ‘open learning analytics’ established by the Open Learning Analytics Foundation has made a more joined-up approach possible. Educational organisations see learning analytics as a central element of their IT provision. They demand control over these tools, how they run and what they are used for. The tools they select, although they come from different providers, use open algorithms and share data according to an agreed set of standards that facilitate transparency and independent validation. A set of well-tested, accessible and standardised visualisation methods is commonly used, so that learners and teachers can confidently use a range of tools. Institutions can easily work with a range of providers to design learning analytics systems that support their strategic vision.

2.5.2. Likert scale results

The results for Vision 5 are very similar to those for Vision 4. Indeed, while data privacy (Vision 4) and open systems (Vision 5) are quite separate issues, there is a strong connection through the perceived ability of open systems to ensure transparency and accountability in data management. Of all visions, this was the one with the highest proportion of respondents rating the vision as ‘highly desirable’, with no respondents rating it as ‘highly undesirable’.

Respondents were much less confident that Vision 5 was feasible, with equal numbers of respondents rating the vision as ‘feasible’ and ‘not feasible’, although substantially more respondents rated it ‘very feasible (4)’ than they did ‘not at all feasible (1)’. There was therefore a consensus that this vision could be achieved.
The results for desirability were almost identical for the three sectors. There was, however, a big difference between sectors in the results for feasibility. For both the School sector and the Workplace sector the largest number of respondents indicated that the vision was rather infeasible (2). In Higher Education, on the other hand the largest number of respondents thought it feasible (3), with a large number asserting that it was very feasible (4). The fact that there were many more respondents from Higher Education than other sectors means that this view prevails in the overall results. But it would be wise to take note of the greater barriers that are perceived to open learning analytics in schools.

2.5.3. Free text responses

The great majority of free text comments on desirability reaffirmed the importance of open systems, and their essential role in learning analytics. There was frequent mention of the need for institutions to be able to control their own systems, and of the support this could offer for transparency on data use. A number mentioned that it is important to realise that open systems are entirely compatible with commercial services and products. There were a few dissenting voices. One respondent asserted that this ‘restricts innovation in the long run’, and in their responses on ‘feasibility’ and ‘action’ mentioned IMS specifications as the best route forward.

As regards feasibility, a number of comments indicated that vendors have an interest to lock-in customers and will work against the vision. Sharing data for learning analytics requires extremely careful attention to privacy, problems which a vendor-specific solutions can avoid completely by keeping data carefully protected and only sharing privacy-neutral analytics. Also, market pressures will pull providers in different directions, and although methods and protocols for sharing are useful, the state of the art will continue to change making this task extremely difficult. Funding streams, organisational and government policy changes will be required to support development of these open tools; although it is entirely feasible in a technical sense widespread implementation at scale will still depend on cost, infrastructure, cultural change and development of appropriate data policies.

The actions recommended by respondents in their comments included practical suggestions for development of common data models and standards, and appropriate policies. Some specific suggestions were offered, for example following the approaches established by the Apache Foundation¹ and by the International Standards Organisation in its technical committee SC36 ISO/IEC JTC 1/SC 36 Information technology for learning, education and training². A need was also identified to demonstrate open systems in action.

2.5.4. Keywords

Commercial pressures, control of systems, funding, marketplace, user control of data.

¹ http://www.apache.org/foundation/
² http://www.iso.org/iso/iso_technical_committee%3Fcommid%3D45392
2.6. Vision 6: In 2025, learning analytics systems are essential tools of educational management

2.6.1. Text of vision 6

*In 2025, learning analytics systems are essential tools of educational management*

In 2015, companies were beginning to develop systems to recommend resources and to predict outcomes. By 2025, these systems are highly developed. A wide range of data about learner behaviour is used to generate good quality, real-time predictions about likely success. Learners, teachers, managers and policymakers all have access to live and accurate information about how well a learner is likely to do. Learners and teachers plan their work on the basis of reliable tools that can produce detailed and personalised recommendations about what should be done to achieve the best learning outcomes. A growing industry offers services to institutions and individuals, advising on how to respond to predictions generated by analytics, and how to take appropriate action in the light of recommendations. Accurate predictive information enables managers and policymakers to expand or contract learning provision before success or failure is evident: you don’t have to wait to see if a course is booming or failing, with funding changes happening quickly.

2.6.2. Likert scale results

![Vision 6: desirability](image1.png)

**Visions of The Future**, Horizon Report

**Vision 6: desirability**

Respondents found this to be a desirable vision, with the most popular choice being ‘desirable’ (3), followed by ‘very desirable’ (4). Very similar scores were given for feasibility.

![Vision 6: feasibility](image2.png)

**Vision 6: feasibility**

The vision was seen as markedly less desirable by respondents from the schools sector, with more respondents finding it ‘not desirable’ (1), than ‘very desirable’ (4). Similarly respondents from the schools sector found the vision to be less feasible than did other sectors.

Respondents who accessed the survey through the web link found the vision to be substantially more feasible than did the invited experts.
2.6.3. Free text responses
The comments on desirability were mostly supportive of this vision (21 comments). This might well be expected, as, many would people would find this vision to be, in the words of one respondent “the goal of using learning analytics”. On the other hand a substantial number of respondents expressed ambivalence (11 responses) because of specific concerns with the vision, while 8 expressed deep concern with the pedagogic implications.

As regards feasibility, some respondents thought that this vision was achievable but not within the 10 year timescale, due to lack of data necessary to produce reliable predictors (e.g. scarcity or unavailability of health, family, motivation, volition data). Others that it will not be difficult to measure and act on metrics, and this may happen in some contexts, but some learners may not benefit because predictions will not be universally reliable, or predictions may mean that investment in some groups is withdrawn or not offered. Some thought that because of the complexity of establishing causality, that business and technical customisation and flexibility will be important to enable success of this vision. It will also depend on cultural change and development of effective policies on ethics, security and privacy, and appropriate business models to meet costs of implementation.

The required actions recommended by respondents centred on four themes. Firstly, ensuring that learning analytics was informed by pedagogy. Secondly, the necessity for further research because, as one respondent put it, “we are still in the ‘proof of concept’ phase. Thirdly, respondents expressed the need for international and national collaboration between institutions. Fourthly, respondents commented on the need for appropriate policies, and, in one case, for relief from regulation when experimenting.

2.6.4. Keywords
Pedagogic effectiveness, policy, prediction, reliability, research, social implications, technical effectiveness.
2.7. Vision 7: In 2025, most teaching is delegated to computers

2.7.1. Text of vision 7

In 2025, most teaching is delegated to computers

In 2015, people were beginning to assemble datasets that could represent learner’s activities. By 2025, these are used on a large scale in teaching, and this has led to the development of enormous datasets containing information about hundreds of thousands of learners. Analysing in detail the progress of such a wide variety of learners has made it possible to provide reliable evidence-based recommendations about the most successful routes to learning, as well as identifying the learning materials and approaches that are most suitable for each individual at each point in their progress. These recommendations are better informed and more reliable than those that can be produced by even the best-trained humans. Learners now spend most of their time working with analytics-driven systems, and the role of teachers has been reduced. The evidence generated by the use of these systems drives education policy.

2.7.2. Likert scale results

This vision was rated the second least desirable of all the visions, after vision 3. Indeed, as vision 3 was the negative vision that “analytics are rarely used in education”, this vision constitutes the least popular of all the ways of using analytics that were presented to respondents. Vision 7 was considered slightly more feasible than it was desirable, but with a majority rating it either ‘not feasible’ (4), or ‘rather unfeasible’ (3).

The results were largely similar for all three sectors, but respondents from the workplace were markedly stronger in their assessment that the vision was not feasible.

There was little difference between the invited experts and respondents reached through the web link, although the latter found the scenario to be a little less desirable.
2.7.3. Free text responses
The majority of comments on desirability stressed the view that, as one respondent put it, “humans are learning best when taught by humans”. Some added arguments as to why this was the case, such as the paucity of information provided by browsing patterns, inability to work with meaning in an automated way, the need for human collaboration and inspiration, and reduction in the creativity agency of the learner. A few dissenting voices suggested that there were positive aspects to the vision.

As regards feasibility, one view was that this is not feasible in some contexts (e.g. workplace learning) because the proportion of eLearning that goes on in those contexts is not high enough now, and is not increasing, for computer driven learning to have much impact. Another view was that whilst it is technically feasible in some educational contexts and disciplines, it will not be in others as it ignores learning through interactions with both peers and the wider social environment, and where attitude, skills and competences like creativity are required to produce individual and novel solutions. Some were sceptical that removal of humans from educational contexts was achievable, e.g. that a human teacher could be better supported by analytics (but not replaced). Marketing (by companies selling solutions) and consideration of cost-cutting (reductions in wage bill) could influence how quickly and deeply this vision is pursued.

In line with comments on desirability and feasibility, the great majority of comments on necessary actions emphasised the need to ensure the participation of humans in teaching, and to understand, as one respondent put it, that “learning takes place in a socio-technical system”. Some respondents mentioned the need for policy and legislative checks on intrusive analytics systems. A dissenting comment suggested that better communication of the benefits would be valuable, while another said that it was important to “ensure that the unions are not killing these initiatives because of data privacy worries”.

2.7.4. Keywords
Commercial interests, effectiveness, human values, pedagogy.
2.8. Vision 8: In 2015, analytics support self-directed learning

2.8.1. Text of vision 8

In 2025, analytics support self-directed autonomous learning

In 2015, learners in educational institutions and in businesses had to follow a curriculum developed by others. In 2025, they create groups that work together to decide their learning goals and how to achieve these. A ‘Learning Trajectory System’ uses analytics to support information exchange and group collaborations, and learners receive support from mentors, rather than teachers. Activity towards a learning goal is monitored, and analytics provide individuals with feedback on their learning process. This includes suggestions, including peer learners to contact, experts to approach, relevant content, and ways of developing and demonstrating new skills. Formative assessment is used to guide future progress, taking into account individuals’ characteristics, experience and context, replacing exams that show only what students have achieved. Texts and other learning materials are adapted to suit the cultural characteristics of learners, revealed by analysis of their interactions. As a result, learners are personally engaged with their topics, and are motivated by their highly autonomous learning. The competences that they develop are valuable in a society in which collection and analysis of data are the norm. There is also convergence between the learning activities of the education system and the methods used by employees to develop their knowledge and skills.

2.8.2. Likert scale results

![Vision 8: desirability](image)

![Vision 8: feasibility](image)

Figure 8: Vision 2 desirability and feasibility

This vision was rated the third most popular in terms of desirability. Indeed, the two visions rated higher (4 & 5) are concerned with open infrastructure and control of data, and so vision 8 is the most highly rated vision which focuses on the pedagogic application of learning analytics. Half of the respondents rated this vision as ‘very desirable’ (4), with over a quarter of respondents rating it ‘desirable’ (3).

Respondents were more cautious regarding feasibility, with ‘feasible’ (3) the most popular response.
The differences between responses from the three sectors was small, but it is worth noting that ‘schools’ and ‘workplace’ respondents were a somewhat less enthusiastic than ‘higher education’ respondents. Similarly the invited experts were more positive about the vision than respondents from the web link, in both desirability and feasibility.

2.8.3. Free text responses
The comments on desirability largely concerned the pedagogic merits of the learning scenario depicted in the vision (29 comments). There were, however, a significant number of comments which were either ambivalent about the vision (11 comments) or negative about it (7 comments). These ambivalent and neutral comments raised doubts about, for example, the ability of learners to understand learning goals, or to correctly interpret the results of analytics, and the social consequences of tailoring materials to cultural preferences.

Key views expressed include that there are too many dependencies, including the systems, links to relevant content and lack of existing structures for this vision to be achieved at wide scale with 10 years. It underestimates the strength of institutional inertia, i.e. it may be possible in the workplace contexts but is unlikely in school or university systems. Some were sceptical that technological solutions to meet this vision would be ready by 2025, and even if they were, that ‘teaching by robots’ would not be politically and socially acceptable. However, other took the view that forms of collective and social earning have already been implemented within formal education and MOOCs, so this vision can be seen as supporting existing practices. The issues of how certification changes in response will be critical.

Many of the requested actions concerned promotion of the pedagogy associated with the vision. Some mentioned the need to research into and demonstrate the effectiveness of these techniques. Others mentioned the need to support the approach with interoperability and privacy specifications, and with changes to certification.

2.8.4. Key words
Pedagogy, effectiveness, inertia, technical challenges, certification, policy, privacy.
3. Themes that emerged from the data

We have so far discussed the results on a vision-by-vision basis. Our purpose, however, is not to establish a shared vision for learning analytics. Nor is it simply to rate our visions in order of desirability and feasibility. Rather we seek to use the responses to the visions as a way of understanding the issues which concern those participating in the field, the drivers which are impacting on the future of learning analytics, and the actions which it would be appropriate to take to enhance that future. We have therefore cumulated the free text data which we have collected for all the eight visions, and coded them to identify the themes which recur in them. The method which we have used is described in section 1.3.7 above, and the themes which emerged from this process are shown in the following table:

Table 2: Themes that emerged from the data

<table>
<thead>
<tr>
<th>No.</th>
<th>Theme</th>
<th>When the theme code was applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Affect</td>
<td>Any reference to feelings or emotion</td>
</tr>
<tr>
<td>2</td>
<td>Alienation</td>
<td>Comments which stressed the need to include humans in the analytics process, or which were concerned the negative impact of analytics on society and relationships.</td>
</tr>
<tr>
<td>3</td>
<td>Complexity</td>
<td>Discussion of the organisational or technical difficulties and challenges, or the need to create new tools. Also statements arguing the opposite, that deployment is straightforward/easy.</td>
</tr>
<tr>
<td>4</td>
<td>Cost</td>
<td>All discussion of financial matters, not ‘resources’ in a broad sense. Also mention of the importance of the market.</td>
</tr>
<tr>
<td>5</td>
<td>Ethics</td>
<td>Concerns about whether learning analytics interventions were good for the people involved. Ethics was defined as being distinct from privacy.</td>
</tr>
<tr>
<td>6</td>
<td>Experience</td>
<td>Argument on the basis of respondents own current practice, and their experience of achieving, or failing to achieve, something specific with analytics in the world today.</td>
</tr>
<tr>
<td>7</td>
<td>Pedagogy</td>
<td>Discussion of educational methods, including training for teachers</td>
</tr>
<tr>
<td>8</td>
<td>Power</td>
<td>Personal, social and political coercion; organisational structures; and contexts where learning analytics will be unable to function.</td>
</tr>
<tr>
<td>9</td>
<td>Privacy</td>
<td>Personal, professional and political concerns about the control and use of data. This was defined as being distinct from ethics.</td>
</tr>
<tr>
<td>10</td>
<td>Regulation</td>
<td>References to laws, rules, policies, etc.</td>
</tr>
<tr>
<td>11</td>
<td>Standards</td>
<td>Reference to technical standards for the interoperability of systems.</td>
</tr>
<tr>
<td>12</td>
<td>Temporality</td>
<td>All discussion of time, including ‘just in time’, delay, later use of data, timeliness, etc.</td>
</tr>
<tr>
<td>13</td>
<td>Validity</td>
<td>Discussion of reliability, generalizability, comprehensibility, worthwhileness, correctness, meaning.</td>
</tr>
</tbody>
</table>

In the remainder of this section we discuss each of the themes which emerged from the cumulated texts, and summarise the associated data. An overview of the number of codes applied to each vision is provided in Appendix 2: Coding Summary Chart.

For details of how many times each element was mentioned in the free-text responses to the survey, see Appendix 2: Coding Summary Chart.
3.1. Theme: Affect

3.1.1. Affect: Key words
Motivation, perception, transparency, volition

3.1.2. Affect: Main aspects
The word ‘affect’ as we use it here refers to the expression of emotion in relation to the visions. Several respondents discussed learners’ and teachers’ attitudes to being tracked and/or monitored. Other descriptions of teachers and students feelings included that both groups may be frightened by the introduction of learning analytics solutions due to loss of control (visions 1, 2 and 5). Some noted that the attitudes of companies and governments will influence the degree and speed of take up of analytics, whether or not these attitudes are informed by evidence. Transparent behaviour (supported by open systems) was seen as desirable, and some teachers can be inspiring and/or confrontational (and computer driven teaching may not be). The idea of analytics systems enabling ‘covert (?) shaping of learning’ was mentioned (vision 7), and the idea of analytics solution providers ‘over-promising’ on the capability of their systems. A view that analytics would not be able to gain understanding of learners’ personal needs and motivations (visions 1 and 7) was put forward.

3.1.3. Affect: Most relevant visions
Issues of affect appeared most frequently in responses to Vision 1, closely followed by vision 5, and 7 and 3. With respect to Vision 1, some mentioned that the vision described students being monitored, but not teachers and that “Learning is an essentially social activity which relies on mutual trust and confidence.

3.1.4. Affect: Least relevant visions
Affect was not mentioned at all in connection with vision 8, and only a few times with respect to visions 4 (e.g. “The cynic in me suggest I am being idealistic if I think this will really happen”) and 6 (e.g. “Wow big brother ahead …..i would apply those tools to policymakers first”). These are visions that most respondents saw as being desirable (see Figure 12: All desirability data).

3.2. Theme: Alienation

3.2.1. Alienation: Key words
Automation, communication, dystopia, humanity, intrusion, policy, privacy, resistance, society.

3.2.2. Alienation: Main aspects
Alienation is used here to indicate comments which either
a) rejected learning analytics in affective language, or in terms of social exclusion
b) ascribed an emotional response or experience of social exclusion to others.

Many respondents said that analytics techniques combined with invasive tracking methods would meet with a personal response that would be a barrier to successful adoption of learning analytics. Others predicted a backlash and social resistance “teachers will resist having the sensors pointed at them”, or lamented the lack of resistance. It was suggested that some areas of learning analytics should simply be avoided, in the words of one respondent “there are some barriers that we shouldn’t cross.”
A key common concern was a contrast between “Real human beings” and the designers of systems, who are members of a technocratic elite. Mention was made of Orwell and ‘big brother’ and of the loss of humanity and inter-personal contact. One respondent captured this social unease by asking if the designers of machine-driven learning systems would want their own children and grandchildren to be educated with them, or for the systems to replace their own elite universities. The “scary” prospect of “technology fanaticism” is seen in a threat because “we are not robots” or “automatons” to be controlled by “algorithmic overlords”.

More specifically with regard to education, many comments expressed the fear that teacher-student relations would be undermined by the use of analytics, to the detriment of authentic educational practice. There was a perception that the “sole reliance on technology will simply pigeon hole learners”, creating stereotypes that undermine the flexibility needed to respond to diverse needs. The result could be greater social exclusion. A large number of comments stressed that humans should remain in charge of decision making, and that information overload and non-negotiable learning outcomes are already a threat to this. This was related in some comments with a rejection of the profit motive in analytics interventions, “... otherwise people will be at the mercy of judgement by proprietary systems”.

Respondents suggested two possible courses of action. Some felt that certain scenarios should be abandoned because they were too intrusive or otherwise objectionable. Others mentioned improved popular engagement in policy and better communication of policy, enhanced privacy control, and demonstrable value to users, as means whereby alienation could be counteracted.

3.2.3. Alienation: Most relevant visions
The vision which stimulated most discussion of alienation was Vision 7: Analytics help learners make the right choices (25 comments). Respondents generally referred to the undesirability of machines taking decision making in general out of human hands, and in particular in the field of education. This was felt to be dehumanising, to ignore important aspects of human nature. It was suggested that mechanised analysis would tend to lead to reinforcement of existing social divisions, and create pressure for conformity. Those who commented varied between fearing the consequences of technological omnipotence, and expressing scepticism that data analytics would be capable of substituting for human judgement.

The other visions which received large numbers of comments coded for alienation are Vision 6: Learning analytics are essential tools (17 comments) and Vision 1: Learners are monitored by their learning environments (16 comments). As with Vision 7, comments on these visions often referred to the undesirability of ceding human judgement to machines, and the loss of human values and independence. However, visions 1 and 7 additionally depend on massive collection of data. In vision 1 this concerns the gathering of very high density data in the classroom, whereas in vision 7 the data is gathered and compiled from educational records across the education system. This focus on massive data collection seems related to a strand of comments referring to invasion of privacy, ubiquitous monitoring and increased control of personal action.

3.2.4. Alienation: Least relevant visions
The visions with the least comments coded for alienation are Vision 5: Open systems are widely adopted and Vision 4: Learners control their data. Both of these visions implicitly address concerns
about privacy and social control of learning analytics which are the key threads related to alienation. It therefore seems reasonable to suggest that the lack of comments coded for alienation on visions 4 & 5 suggests that these visions are acceptable to respondents who experience alienation with regard to other visions, and that open development of learning analytics and mechanisms for personal control of data are important initiatives if learning analytics is to be widely acceptable.

3.3. Theme: Complexity

3.3.1. Complexity: Key words
Barrier, challenge, social, technology, understanding.

3.3.2. Complexity: Main aspects
Complexity was a major theme in the responses – it was the third most-frequently occurring theme. (For full counts, see Appendix 2: Coding Summary Chart.) It covers complexity and challenges, whether technical or more broadly. As well as responses saying there are complexity and challenges, it includes those making the opposite case, that it is relatively straightforward, simple, or has already happened in other fields (as distinct from the Power theme, which codes contexts where learning analytics may be more or less desirable, feasible, etc.).

There are two main aspects of this theme. The first is from respondents arguing that there is a lot of complexity, in terms of the technical challenges to be solved, and in terms of the humans making sense and use of the data. These respondents tended to see this complexity as presenting a barrier to the visions, although views varied on how much of a barrier, from a minor blockage, to ‘very difficult to achieve’, to making the vision completely infeasible. The second aspect is from respondents arguing that it would be relatively straightforward, that there are few or no technical or social challenges, or that if there are, they are easily addressed. These respondents often made references to situations or contexts where this aspects of the vision was already happening, and cited the rapid pace of development in the technical field.

It is hard to simply summarise the balance of many responses to many different visions, but most of the responses were very much in line with the respondent who said: “The feasibility of this is based on overcoming significant social and political hurdles. It is feasible technically.” It is important to note that almost no respondents argued that it was not complex technically, and some of the few that did implied that they were not familiar with the technical details. Thus the respondents in general agreed that there was considerable technical complexity, as well as social and political complexity, but on balance thought the technical challenges were significantly more likely to be overcome than the social and political ones. There was much support for the idea that these broader considerations were the most important ones.

3.3.3. Complexity: Most relevant visions
Responses to almost all the visions dealt with complexity as an issue. Respondents generally engaged with the particular complexity of the vision as set out. So, for instance, respondents to Vision 2 (Learners’ personal data are tracked) gave examples of existing sensors and Internet of Things technologies as arguments for the vision being feasible.
3.3.4. Complexity: Least relevant visions
There was relatively little mention of complexity in responses to Visions 3 and 7. For Vision 3, this is probably because that vision (Analytics are rarely used) does not require challenges of complexity to have been overcome. For Vision 7 (Analytics help learners make the right choices), it may have been because respondents were focusing on the pedagogic aspects of the vision.

3.4. Theme: Cost

3.4.1. Cost: Key words
Budget savings, business models, commercial models, costs, economic models, funding models, government funding, market place, value

3.4.2. Cost: Main aspects
The use of learning analytics was associated with a perceived need to bring down the cost of education and reduce the cost of workplace training. ‘Economics continue to pressure the traditional classroom which makes this vision [7] a necessity.’ ‘Bringing down costs is a major driver in educational development.’

Many respondents who mentioned elements of cost felt they were at the mercy of market forces and that analytics would be introduced because companies wanted to make money by selling them. One commented pessimistically on Vision 3, ‘Common sense won’t prevail in light of the power of money’. Another responded to Vision 7, ‘Economics continue to pressure the traditional classroom which makes this vision a necessity.’

Conversely, some expected Vision 5 (open systems for learning are widely adopted) to fail because it would stop companies making money from analytics, so economic forces would limit openness.

In the context of Vision 4 (individuals control their own data), the value of data was an issue: ‘we need to increase awareness of the value and trading power of data’ and ‘Humans need to understand that their data is an equal to a currency. Respective measures must be taken to work out the exchange rate.’

Elsewhere, cost was typically associated with money, although one respondent identified other form of value: “A lot of the value of education is not in supporting individual growth but in developing community growth, norms, and so on.”

There was a concern that money would be wasted on unfruitful lines of research and valueless tools.

3.4.3. Cost: Most relevant visions
Issues of cost appeared most frequently in responses to Vision 6 (open systems). Several people feared that the vision would be blocked by vendor lock-in. Some suggested developing a new economic model or a new funding model, using government funding to support this vision.

References to cost related to Vision 1 (classrooms monitor the physical environment to support learning and teaching) focused on the need to prioritise thoughtfully and avoid wasting money. “Focus valuable and restricted research time and funding on what is more feasible, reliable, valid and of immediate value.”
3.4.4. Cost: Least relevant vision
There were few responses related to cost in relation to Vision 3 (analytics not used) and no suggestions that expense would limit the use and development of analytics.

3.5. Theme: Ethics

3.5.1. Ethics: Key words
Abuse, context, culture, exploitation, personalisation, policy.

3.5.2. Ethics: Main aspects
There were concerns expressed across the visions about the need to ensure the ethical use of data for educational purposes, and its exploitation for other purposes, e.g. through the development of policies to guide the ethical use of analytics systems. Respondents made reference to unethical practices such as attempts to game learning analytics systems, and remarked that unethical practices could cause vision 3 (“In 2025, analytics are rarely used in education”) to occur. There were also mentions of the manner in which learning analytics could be applied e.g. that teachers’ roles should not be reduced, but changed as learning is a ‘human, socially embedded, communal activity’ (in response to vision 7).

3.5.3. Ethics: Most relevant visions
The visions which drew the most comments that mentioned ethical issues with respect to desirability, feasibility and actions were visions 2, 3 and 1 respectively, with vision 2 drawing the most overall. Responses to vision 2 mentioned potential of abuse of data and exploitation of data for purposes other than education. There were also concerns that the vision relies on an ideal, that it aims at matching people with that ideal, of meeting externally defined goals instead of maximising individual potential in a local context. (A response to vision 6 mentioned a related concern, i.e. the potential for analytics to block opportunity for individuals to transcend their background). Responses to vision 2 included concerns that ‘those most in need will not opt in’ to having necessary data collected, prompting need to act on their behalf. Requirement of technology could limit access.

3.5.4. Ethics: Least relevant visions
Vision 8 drew the fewest comments mentioning ethical issues. This could be because the vision stresses the use of reliable and valid learning routes for individual learners. However, one of the comments raised a concern: ‘selecting study material based on “the cultural characteristics of learners” sounds like a good (bad!) way to ensure a deep split between different groups by giving them different educations on top of other differences’.

3.6. Theme: Experience

3.6.1. Experience: Key words
Commercial pressure, communication barriers, failure, policies, success, technology.

3.6.2. Experience: Main aspects
Comments which are coded under as relating to experience are those in which the respondent appeals to their personal experience of learning analytics, or the accumulated experience of the community, as a basis for arguing in favour or against the vision concerned. A detailed breakdown of how many times this code was used is available in Appendix 2: Coding Summary Chart.
A very wide range of types of experience were mentioned as being relevant to the visions. Moreover, the experiences were divided between those that supported a positive view of the future of learning analytics, and those which were provided as examples of constraints on the future of learning analytics, with about 60% finding positive evidence in their experience, and about 40% finding negative evidence. This is in line with our comments elsewhere that

a) learning analytics is deeply entwined with wider social, economic, organisational and technological processes
b) there is substantial disagreement among experts and enthusiasts for learning analytics about the way in which the field is likely to develop, and the degree to which it will fulfil its promise.

Much of the positive evidence identified in experiences concerned the present trajectories of technologies and practices that are required for the successful implementation of learning analytics. These include pervasive computing, smart environments, the internet of things, biometrics and wearables. There were also dissenting voices who pointed out that IT departments do not talk to each other or have good communication with their institution, and complained of “Over-promising, the arrogance of the people who pontificate about this, and their ignorance of what it actually takes to learn and to teach”.

In other areas the conclusions from experience were more contested. For example open learning analytics was supported by the fact that many algorithms are already public, that open collaboration is underway to support learning analytics infrastructure, and that open innovation is an established business model. Similarly IP regulation over human genome patents was given as a positive example. On the other hand, it was argued “money talks” and companies like to keep their methods and data behind IP barriers, while public interests are not well coordinated to fight against private interests. Gatekeepers, it was suggested, would maintain control, as they have in medical analytics.

A number of respondents pointed to the work being done in the corporate world and in military training, as evidence that data driven systems can be effective. However others pointed to experiences of education which do not fit these examples, for example the lack of widespread adoption of programmed learning and intelligent tutoring systems, and areas where prediction is not perfect (the weather). Another respondent pointed to the need for teachers to stimulate learners to engage in self-paced courses, and the general lack of progress in increasing the proportion of online education.

A number of respondents pointed at experience which indicates that concerns about privacy are exaggerated. They mentioned that medical data and financial data is already shared and managed without major problems. Education, they point out, already keeps extensive records on learners, and carries out predictive analysis by means of formative assessment. Policies for ethics, data governance and security are beginning to be put in place. Others see a trend to abuse of data, and a neo-liberal agenda was mentioned, the reduction of learning to outcomes, and KPIs. The InBloom experience (Horn 2014) indicates that privacy should be taken seriously and built in from the beginning.

Experience also showed that more needs to be done in sharing knowledge and experience, both in academia and in the EU.
3.6.3. Experience: Most relevant visions

Comments made by respondents were coded for ‘experience’ most frequently in Vision 3 (25 comments). This describes a future in which learning analytics has been side-lined, which would clearly be a matter of concern for our respondents, who are almost all engaged in the field in one way or another. This vision is also one which relies on the extrapolation of current social and political processes, which is topic that many people will have an opinion on. The opinions were very divided, with 12 comments cited experience to in support of the prediction that analytics would be rarely used, while 13 comments argued the contrary. The comments were also very polarised, with comments ranging from “The vision is so implausible it barely warrants comment” to assessing it as “very probable”.

Vision 7, also generated many comments. This vision suggests that massive data bases or anonymised student information will enable systems to make better recommendations that teachers, a situation that would threaten the current nature of the education system, and also the professional activities of many respondents. 8 comments cited experience to support the vision, while 10 argued that human input was an essential part of education.

As regards vision 5 on open systems (18 comments), no experience was cited to indicate that the vision was undesirable, but respondents were equally divided between arguing that current work would lead to open systems, and arguing that commercial interests and lack of communication would prevent the vision developing.

Visions 1 (16 comments) and 6 (14 comments) both propose a world in which learning analytics has developed and works effectively. In these scenarios experience was largely cited to indicate that the vision would be practicable, while objections to the vision are to be found under other codes, such as alienation and privacy.

3.6.4. Experience: Least relevant visions

The theme of experience was least frequently coded for vision 2, perhaps indicating that the technology of sensors is unfamiliar to respondents. It is interesting that there was little evidence of experience for visions 4 (5 coded) and 5 (6 coded), both of which are rated as highly desirable by respondents. This enthusiasm plus lack of experience suggests a gap in the research being carried out, and presumably also in the institutional and financial support for such research.

3.7. Theme: Pedagogy

3.7.1. Pedagogy: Key words

Educators, learn, learner, learning, pedagogy, teach, teacher, teaching.

3.7.2. Pedagogy: Main aspects

Pedagogy was the most common theme in the responses. (For counts, see Appendix 2: Coding Summary Chart.) Many respondents raised issues about learning analytics and the processes of teaching and learning, and about awareness and training for learners, teachers and managers to make best use of learning analytics.

The most common response in the pedagogy theme were concerns that learning analytics represents poor pedagogy, or risks being used for poor pedagogy. These responses argued that the
data is not useful to understand learning, or particularly “higher-order learning”, as opposed to mechanical behaviours, physical skills, and “purely the acquisition of facts”, which were thought to be more likely to be the focus. They argued that analytics doesn’t (or may not) capture essential elements of learning, such as motivation, volition, and the human connection (see also the Alienation theme). Many respondents were firmly of the view that effective learning required a human teacher, but not all of them. One even commented, “To the extent that the teacher negatively affects the quality of learning, the teacher should be removed.”

Some respondents implicitly believe that our current understanding of learning is good; most of those respondents were at least somewhat sceptical that analytics could capture what we know about good pedagogy. Others argued that we need more research in to learning itself, and that learning analytics might help.

Personalisation, responsiveness and adaptation were a common issue raised under this theme. Most responses were of the view that learning analytics would help achieve personalisation and individual adaptation, but not all, and some were not convinced that these would be good things to achieve anyway. A small number of responses were concerned about the opposite: that analytics would make learning more one-size-fits-all.

There was concern about what values such systems will “embed”: whether existing poor pedagogical practice or ineffective power structures (cross-reference Power), the ill-informed views of programmers and data scientists. Some respondents were concerned that a market view of learning would be embedded; a small group of others were concerned about the opposite: that it would all be about “educational approaches” with no role for the market.

Most responses were cautiously positive: it “does have the potential to help teachers and educators”, but they were nuanced: it “has a role to play”, rather than being the entire answer.

A key issue raised under this heading was a perceived need for training, development and awareness-raising around analytics. Most often, it was teachers who were seen as needing this professional learning, but respondents also mentioned a need for managers and learners themselves to gain skills in interpreting, using, and acting on the data in appropriate ways: “increasingly learners, families, educators and others [will] acquire experience and skills in judging when to accept predictions and when to view them with some scepticism and apply additional knowledge”.

3.7.3. Pedagogy: Most relevant visions
This theme was mentioned by many respondents to all visions, probably because respondents felt that pedagogy was an important factor for all of them.

3.7.4. Pedagogy: Least relevant visions
Not applicable, because this theme was mentioned in relation to all visions.

3.8. Theme: Power

3.8.1. Power: Key words
Big Brother, data control, empowerment, human rights, law, misuse, policy, surveillance
3.8.2. Power: Main aspects
Respondents identified several levels of power associated with these visions. At an individual level, some welcomed opportunities to empower the learner; while some worried about a loss of agency by the learner. Others believed that education should be led by a teacher, who can make decisions that learners are not experienced enough and analytics not nuanced enough to make. At an institutional level, there were fears that control over learning would be put in the hands of system designers, programmers and managers rather than teachers. At a national level, there were concerns about the development of a surveillance state, and large-scale monitoring programmes. At an international level, there were issues about the aims and values of education, and about a possible need to expand our definition of human rights.

3.8.3. Power: Most relevant visions
Issues of power were frequently raised in relation to Vision 5 (open models), particularly the need to balance power between users and vendors: “a good balance between empowering institutions without crippling companies from being innovative”. The important role of government and national organisations in proposing and implementing shifts in policies, standards and practices was associated with this.

Vision 4 (data control) provoked strong reactions around human rights: “there are new ways to exploit, manipulate and assert power over others thanks to the data we hold about them. This power needs to be curtailed.” There were calls for action on this issue from parents, student bodies, grassroots movements, political representatives, policy makers and governments.

Several of the visions, but particularly Vision 1 (monitoring the environment) provoked references to Big Brother and a dystopian Orwellian future, including: ‘a tool for asserting power’, ‘Are we ready for a Educational Big Brother?’ “the implications for learning outside the classroom require a surveillance society beyond anything society would currently find acceptable’ and “teachers would resist”. Three people described this vision as a little “scary”.

3.8.4. Power: Least relevant visions
Visions 2 (data tracking) and 6 (essential tool) provoked the fewest references to power. However, many of these references were intense. One respondent to Vision 2 believed that “People would become slaves of their sensors and their diagnosis & recommendations apps.’ Another commented, ‘sounds like we are robots controlled by our algorithmic overlords”. More positively, one respondent to Vision 6 saw learning analytics as a way of giving more power to education: “Rational educational system designed to maximize student outcomes. Increases human capital. Education overcomes historical injustices.”

3.9. Theme: Privacy

3.9.1. Privacy: Key words
Big brother, control, power, regulation, surveillance.

3.9.2. Privacy: Main aspects
The responses on the privacy theme can be split into two broad categories, i.e. privacy related ‘threats/barriers’ to successful implementation of learning analytics solutions and privacy related ‘enablers/opportunities’ for the successful implementation of learning analytics solutions.
In the barrier/threat category, some respondents considered the amount of monitoring necessary for some visions would be too much for some social groups, e.g. “a Big Brother scenario, with deep intrusion into the privacy and integrity of students, which is not needed for effective learning analytics” and in some situations “the implications for learning outside the classroom require a surveillance society beyond anything society would currently find acceptable” (vision 1). Another barrier identified is that if students are able to opt out of some or all of their data being analysed, then potentially those who opt out may be those most in need of support (as a counter, some respondents observed that there is a need for “institutions and mechanisms that are independent and act on behalf of students and teachers”). Some identified privacy regulations as a potential barrier in some jurisdictions “it is difficult to say how feasible it is, especially in EU” (vision 1). There was a concern about the cost of enabling easy-to-use tools to set and adjust privacy settings, in terms of both technology development, and also in terms of time to raise awareness.

In the ‘enablers/opportunities’ category, one respondent remarked that risks of intrusion are not a sufficient reason to reduce investment in learning analytics (vision 3), and “many people will (do) continue to be comfortable with their data being used”. There is a need for need for an “up-to-date, transparent legal frameworks to protect the individual” (vision 2). “Focus on how to manage private data has to be the most important issue”. Individuals must have power to decide, and organisations must be transparent about what data they use and how they use it. There are “conceivable scenarios where it is more beneficial for the users to not have full control of their own data, particularly where ill-informed decisions may have life consequences” and there is a need “to consider the greater good of sharing non-identifiable data”. It is “likely that institutions and tools developers will ask users to sign away some rights to data as part of the conditions of them or using their services. Some degree of access to data seems necessary to run the institution”. There is a need for “clear guidance around the retention of anonymised data” (vision 4). “Opening up access to data creates a vibrant market for third party tools” (vision 5).

3.9.3. Privacy: Most relevant visions
Vision 4 with a total of 99 comments of which 38 were actions). Only one other vision had more than 20 comments (Vision 1, of which 15 of the 28 relevant comments were about desirability).

3.9.4. Privacy: Least relevant visions
Vision 8 (only 1 comment, about actions). Visions 2, 5, 6 and 7 had 11 or fewer comments about privacy.

3.10. Theme: Regulation

3.10.1. Regulation: Key words
Government, guides, law, laws, legislation, legislature, policies, policy, protocol, protocols, regulation, regulations, rules.

3.10.2. Regulation: Main aspects
This theme is concerned with laws, regulations, policy and rules. Compared to other themes, it was mentioned by respondents a medium amount.

Almost all responses mentioning regulation said or implied that there was a need for more or better regulation: very few responses argued for deregulation, repeal of legislation or a loosening of
existing policy. The main exception was in responses to Vision 3 (Analytics are rarely used), where several responses argued that the restrictions suggested in that negative vision would be undesirable or unnecessary. There were also some responses arguing that “rules and regulations [...] could cause delays and hinder carrying it out”.

Regulation was suggested at a wide range of levels: from rules or policies for individual organisations up to formal legislation at national or supra-national level.

Overwhelmingly, respondents who mentioned regulation were concerned to enforce ethics, privacy, ownership, and transparency, building on or strengthening existing Data Protection practice. (See also Ethics (Section 3.5) Privacy (Section 3.9), Power (Section 3.8)). Other respondents cited a need for regulation to ensure security, and to encourage or mandate openness.

Although most respondents were implicitly confident in the possibility of effective regulation being developed, many were concerned that it would be a difficult and complex process. There were even some comments voicing doubt that policymakers would be able to rise to this challenge, e.g. “I don’t see policymakers able to reach such sophisticated decisions”.

Many responses mentioning governments and policymakers also called for funding to support research and awareness-raising in this field.

### 3.10.3. Regulation: Most relevant visions

This theme was mentioned under all the visions. The vast majority of responses in this theme were in the final open text section concerned with actions needed. Indeed, regulations were the most common suggestion for action required, or one of the most common, for all visions. This suggests that the respondents saw regulations as the most important action required in the field of learning analytics.

### 3.10.4. Regulation: Least relevant visions

The least relevant visions are Vision 2: In 2025, personal data tracking supports learning, and Vision 7: In 2025, most teaching is delegated to computers. For Vision 1, the proposal that personal data would be managed by the data subject appears to have allayed concerns. In Vision 7, the concern was not with the regulation of data, but rather with the implications of the results of analysis.

### 3.11. Theme: Standards

#### 3.11.1. Standards: Key words

Standards, standardization, interoperability, API, IMS, LTI, Caliper, Experience API, xAPI, TinCan, SC36

#### 3.11.2. Standards: Main aspects

*Standards* was the second least-common theme raised by respondents. It was not a frequent response, but those respondents who did raise it tended to leave lengthy and informed comments about it.

Almost all the responses about standards said or implied that they were necessary or desirable in this field: “there is a need for standards”, “clear standards should be developed”. “Limited interoperability” was cited as a problem that standards could help overcome.
A wide range of standards and standards bodies were raised, including SC36\(^3\) (the appropriate technical committee of the International Standards Organisation), IMS Learning Tools Interoperability\(^4\), and IMS Caliper\(^5\), and Experience API/TinCan\(^6\).

As well as standards about the data in learning analytics, some respondents also saw a need for standards about broader issues such as privacy, ethics, data security, and good practice (see also the Regulations, Privacy and Ethics themes).

**3.11.3. Standards: Most relevant visions**

Almost all the responses coded under the Standards theme addressed Vision 5 (Open systems are widely adopted), which is largely concerned about standards. There were several Standards responses to Vision 4 (Learners control their own data), which mainly saw effective standards as a key enabler for this vision.

**3.11.4. Standards: Least relevant visions**

Very few comments about standards were raised in response to the other visions, and where they were, they tended to be from respondents who clearly had expertise in standards. This suggests that experts are unlikely to mention standards in learning analytics unless they are specifically prompted or they are of particular interest to the expert.

**3.12. Theme: Temporality**

**3.12.1. Temporality: Key words**

Duration, initial state, just-in-time, rate, speed, sufficiency, timescale.

**3.12.2. Temporality: Main aspects**

There were comments across the visions about the speed at which changes would occur. Some respondents thought that aspects of the visions were already occurring, others that within 10 years is achievable, and some that it will take longer. Some noted that various requirements necessary for some of the visions may take different time scales to come to pass, e.g. the technology may be in place by 2025, but policies and user acceptance may take longer.

Other comments reflected on time with respect to the nature of support that learning analytics could enable e.g. just-in-time, or to enable teachers to detect problems earlier. Some were concerned that teachers may not enough have time to act on the data.

There were comments about the time-span that the data necessary for some aspects of the visions could legally be stored for.

**3.12.3. Temporality: Most relevant visions**

Vision 5 (“In 2025, open systems for learning analytics are widely adopted”) had the most comments coded as being relevant to temporality (i.e.15). These included a remark that standardised tools and methods will restrict innovation in the long-run, causing the field to develop more slowly.

---

\(^3\) [http://www.iso.org/iso/iso_technical_committee%3Fcommid%3D45392](http://www.iso.org/iso/iso_technical_committee%3Fcommid%3D45392)

\(^4\) [https://www.imsglobal.org/activity/learning-tools-interoperability](https://www.imsglobal.org/activity/learning-tools-interoperability)

\(^5\) [https://www.imsglobal.org/activity/caliperram](https://www.imsglobal.org/activity/caliperram)

\(^6\) [https://tincanapi.com/overview/](https://tincanapi.com/overview/)
other hand, interoperability standards will ensure that Learning Analytics technology may be embedded into next generation of educational systems. There were remarks about speed (“Similar to the (slow) growth of the OER movement, 2025 seems reasonable”), comparison to speed and depth of adoption in related fields (despite the popularity of Learning Management Systems, interoperability specifications are not completely supported by most; however it is possible that de facto standards arise) and change (the Learning Analytics state of the art will continue to change making standardisation extremely difficult).

Vision 1 and vision 7 had 10 comments each. With respect to Vision 1, respondents noted that it would be advantageous to have data so as to be able to provide just in time support, or (Vision 3) to detect problems earlier. However, some were concerned that teachers may not enough have time to act on the data. Respondents also noted things that might affect speed of implementation “however it might be human factors, rules and regulations that could cause delays and hinder carrying it out”.

For Vision 7 respondents commented that learning analytics should mean that learners can spend same amount of time with teachers, but the time is spent more effectively. Others thought that it will take more than 10 years to achieve, e.g. the slow pace of institutional change will act against this happening within 10 years; “A cultural and educational shift is needed – and those are slow”.

Vision 3 had 9 comments, of which twice as many were about desirability as compared to feasibility (i.e. 6:3). Reference was made to waves of higher and lower usage due to availability of technologies and privacy issues, and to the increasing risk of private data leaking unless privacy is designed into all learning analytics systems from the beginning.

3.12.4. Temporality: Least relevant visions

Visions 2 and 8 had the fewest comments that were coded as relating to temporality, i.e. 3 for each vision. This may be because although temporal issues such the speed at which necessary changes would occur, or different rates of evolution of necessary components are relevant to these visions, other issues were more important for most of the respondents.

3.13. Theme: Validity

3.13.1. Validity: Key words
Assumptions, education, generalizability, learning, reliability, research.

3.13.2. Validity: Main aspects
Here, ‘validity’ is used to refer also to the reliability and generalizability of learning analytics and to all aspects of the research on which they are based. There is a perceived need to ‘Focus valuable and restricted research time and funding on what is more feasible, reliable, valid and of immediate value.’ However, carrying out this type of research poses several problems. One of these is concerned with philosophical questions about the nature of learning, whether it is something that teachers do to pupils, a process of ‘change, growth, transformation’, or something else. Without an agreed definition of learning, it is difficult to define learning success, how it can be operationalized, what data will provide evidence of it, and how quickly it should be apparent.

Some respondents felt learning analytics research should focus on areas that appear straightforward and close to solution; others felt if it should be ‘tied to pedagogical outcomes’ or should begin by digging into the ‘deep complexity of learning’. Many suggested areas for research that focused on
areas not easy to define or capture such as orchestration of learning, higher-order thinking skills, attitudes, skills, creativity and critical understanding. They also identified confounding variables including ‘pressures of work, family, social life; lack of intrinsic motivation; making curricula sufficiently relevant to people’s lives’.

Respondents stressed a need for users to ‘have the access to question the processes and assumptions under which the data is input, massaged, and output’, to open up the algorithms and success cases and to provide a reliable evidence base for the success of different measures. There was also a call for more work ‘to be done on how students react to data they are given and how that data is presented to them’.

3.13.3. Validity: Most relevant visions
Validity was identified as an issue in relation to Vision 6 (essential tool). Again, this was in the context of problems. One respondent pointed out that ‘very little credible research has demonstrated any real large-scale benefits to learners or institutions.’ There was a worry that that use of analytics can lead to ‘self-fulfilling prophecies’ and an assumption that ‘that the future outcomes are a function of past and present values’. There was also a call for ‘qualitative approaches to study the effects of learning analytics in education’ in order to take into account the many complex issues that cannot be considered adequately using an entirely quantitative approach to educational research.

3.13.4. Validity: Least relevant visions
Only one key issue about validity was raised in relation to Vision 4 (data control). ‘If you don’t have a full data set can you really draw meaningful conclusions?’
4. Conclusions

The objectives of this study, as defined in section 1.2.2, are:

- To explore or expose underlying assumptions or information leading to differing judgments on learning analytics
- To correlate informed judgments on the topic of learning analytics, which spans a wide range of disciplines.

We now discuss our findings in relation to these two objectives.

4.1. Differing judgements on desirability and feasibility

![Disparity between desirability and feasibility](image)

Figure 9: Disparity in attitudes to desirability and feasibility

Figure 9 makes salient those visions for which there was a disparity between desirability and feasibility. The clarity that this representation brings comes at the cost of generating an average for each Likert scale, with loss of information about spread. In the resulting figure a unanimous minimum negative response of ‘not desirable’ or ‘not feasible’ would be represented as zero %, while a unanimous maximum positive response would be represented as 100%. Intermediate values are weighted accordingly.
Firstly, this chart shows that there is a wide variation in respondents’ views of the desirability of the visions, whereas there is much greater agreement on their feasibility. This implies that there is, to some extent, a shared understanding of the capabilities of the technologies which are available to implement learning analytics, but also a wide disparity of views regarding the purposes for which this technology should be used.

Secondly, some visions strong discrepancy between desirability and feasibility:

- Three visions are seen as similar in their desirability and feasibility (visions 1, 6 & 7).
- Two visions have a substantial degree of discrepancy between desirability and feasibility (visions 2 & 8).
- For three visions there is a very strong contrast between desirability and feasibility:
  - Vision 3: In 2025, analytics are rarely used in education
  - Vision 4: In 2025, individuals control their own data
  - Vision 5: In 2025, open systems for learning analytics are widely adopted.

In all three cases the respondents indicate that the discrepancy is driven by the mismatch between technical capability, on the one hand, and social and political implications, on the other. In the case of Vision 3, the concern is that social, political and pedagogic factors will bring about the undesirable abandonment of learning analytics. In the case of visions 5 and 6, the concern is that initiatives which could enable learning analytics to make a positive contribution to education and society will be prevented by social and political factors.

This result warns us against thinking of the future of learning analytics solely in terms of the technical concerns of analytics methods and pedagogical applications.

4.2. Judgements on the eight visions, and their implications
In this section we discuss the main conclusions that can be drawn from responses to the individual visions, and the drivers which these imply. We then identify the three areas of action which can address these drivers.

4.2.1. Vision 1. In 2025, classrooms monitor the physical environment to support learning and teaching
A majority found this vision undesirable, but feasible. Rejection of the vision centred on the intrusiveness of data gathering and concerns about privacy. The technology is available, but the pedagogic application is not ready. There is some disagreement between the sectors and between invited experts and web link respondents.

The principal drivers identified in this vision are:
- Policy on and regulation of privacy and data ownership
- Lack of clear consensus on efficacy of learning analytics
- Pedagogic approach instantiated in learning analytics, and fit to pedagogic context

4.2.2. Vision 2: In 2025, personal data tracking supports learning
The majority of respondents found Vision 2 to be undesirable, but most respondents also found it to be feasible. Many of the required technologies are perceived as being currently available. Privacy
was a concern, but users’ control of data was seen as a positive aspect. Doubts were expressed about the pedagogic efficacy of the vision.

The principal drivers identified in this vision are:
- Users’ control of data
- Pedagogic efficacy of learning analytics
- Ready availability of technology
- Distrust of the profit motive in learning analytics

4.2.3. Vision 3: In 2025, analytics are rarely used in education

Vision 3 was rated the least desirable of all visions, with over twice as many ‘very undesirable’ (1) scores as any other vision. This result contrasts with the mixed and often ambivalent responses to the particular visions of the use of learning analytics presented to respondents. This shows great faith in the relevance and utility of learning analytics, but a lack of clarity of exactly how it the techniques should be used. Respondents were evenly split on whether this vision was feasible, in the biggest contrast between desirability and feasibility of any vision. There is, therefore, real concern among participants in learning analytics that it will not achieve its potential.

The principal drivers identified in this vision are:
- Confidence in the future of learning analytics
- Demonstration of the opportunity presented by the availability of data, and the potential pedagogic benefits of analytics
- Policies and regulations to ensure data privacy

4.2.4. Vision 4: In 2025, individuals control their own data

Vision 4 was rated as being very desirable, and a majority of respondents also thought that it was feasible. This result correlates with the concern for users’ privacy and control of data expressed in many of the other visions. There is therefore a strong consensus in the population consulted that it is ethically essential to regulate control of users data so as to strengthen the rights of the data subject, and that this is also a necessary step if learning analytics is to be widely acceptable. There were some minority voices which pointed out that this would lead to lost opportunities, and that education institutions already collected a lot of data about learners.

The principal drivers identified in this vision are:
- Concerns about lack of regulation to ensure user control of data
- Social acceptance of monitoring
- Demonstration of pedagogic efficacy

4.2.5. Vision 5: In 2025, open systems for learning analytics are widely adopted

Vision 5 had more ‘very desirable’ (4) ratings than any other vision. There is therefore a very strong consensus among the respondents that an open and standards compliant infrastructure for learning analytics is essential. They also believe that this is an achievable goal, but that it will require appropriate funding from national bodies and the European Commission. A place is seen for commercial organisations within open analytics. There were very few negative comments relating to this vision.
The principal drivers identified in this vision are:

- Control by institutions of their own infrastructure
- Commercial pressure from eLearning providers
- Transparency on the collection and use of data

4.2.6. Vision 6: In 2025, learning analytics systems are essential tools of educational management

Vision 6 was, on balance, positively perceived in both Likert scale and free text responses. However, respondents from the schools sector were less enthusiastic than other sectors, with more respondents finding it ‘not desirable’ (1), than ‘very desirable’ (4). They also found it less feasible. This indicates potential conflict in the implementation of predictive analytics in schools.

Invited experts assessed the scenario as being less feasible than did respondents to the web link, which may indicate that this core use case for learning analytics may be less well established than is generally assumed. This aligns with the concerns expressed by some respondents that the effective implementation of such systems will be more complex than is foreseen.

The principal drivers identified in this vision are:

- The demonstrable effectiveness of learning analytics methods
- Social acceptability of monitoring
- The fit between the pedagogy instantiated in learning analytics methods, and the pedagogic context.
- Policy on and regulation of ethics and privacy

4.2.7. Vision 7: In 2025, most teaching is delegated to computers

Vision 7 was the least popular of all the pedagogic approaches to learning analytics that were presented to respondents. Objections centred on the proposal that “Learners now spend most of their time working with analytics-driven systems, and the role of teachers has been reduced”, which was rejected by most respondents, often strongly so. This is consistent with the results for other visions, in which many respondents also place great importance on face-to-face communication with teachers. It is interesting that respondents from the workplace were stronger in their opinion that this approach was not feasible, even though one might expect computer based training to be better established in that sector. There were surprisingly few references to economic factors, even though this is a key aspect of the replacement of teachers by machines.

The principal drivers identified this vision are:

- Pedagogic vision instantiated in learning analytics, and its fit with the pedagogic context.
- Lack of consensus on the effectiveness of learning analytics interventions
- Policy checks on intrusive analytics systems

4.2.8. Vision 8: In 2015, analytics support self-directed learning

Vision 8 was rated the most desirable of the pedagogic scenarios which were presented to respondents through the visions. In broad terms, this is the kind of pedagogy that the respondents would like to see adopted, but they were a little more cautious in terms of feasibility. In alignment with other visions there is a perceived gap between the pedagogic wishes of the respondents, and the likely development of the field.
Respondents from ‘schools’ and the ‘workplace’ were somewhat less enthusiastic than ‘higher education’. Similarly the invited experts were more positive than respondents to the web link, in both desirability and feasibility. This distinction invites reflection as to whether a socio-technical elite is driving an agenda which may not be entirely welcome to the people who will be using the systems. The lack of consensus was clearer in the free text responses, where, despite the popularity of the pedagogic approach described, many comments questioned its efficacy. This vision raises as yet unresolved issues of interoperability, privacy and certification.

The principal drivers identified in this vision were:

- Pedagogic approach instantiated in the learning analytics methods, and fit with pedagogic context
- Lack of consensus on pedagogic methods for learning analytics
- Interoperability
- Policy on privacy and certification

4.3. The range of themes informing the judgements on the visions

Table 3 shows the number of times each theme code was applied to the corpus, together with the key words identified in the coded texts.

Table 3: Summary table of the application of codes, with key words

<table>
<thead>
<tr>
<th>Theme</th>
<th>No. codes</th>
<th>Key words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogy</td>
<td>355</td>
<td>Educators, learn, learner, learning, pedagogy, teach, teacher, teaching.</td>
</tr>
<tr>
<td>Power</td>
<td>313</td>
<td>Big Brother, data control, empowerment, human rights, law, misuse, policy, surveillance.</td>
</tr>
<tr>
<td>Complexity</td>
<td>238</td>
<td>Barrier, challenge, social, technology, understanding.</td>
</tr>
<tr>
<td>Validity</td>
<td>187</td>
<td>Assumptions, education, generalizability, learning, reliability, research</td>
</tr>
<tr>
<td>Privacy</td>
<td>180</td>
<td>Big brother, control, power, regulation, surveillance.</td>
</tr>
<tr>
<td>Regulation</td>
<td>169</td>
<td>Government, guides, law, laws, legislation, legislature, policies, policy, protocol, protocols, regulation, regulations, rules.</td>
</tr>
<tr>
<td>Ethics</td>
<td>132</td>
<td>Abuse, context, culture, exploitation, personalisation, policy.</td>
</tr>
<tr>
<td>Experience</td>
<td>109</td>
<td>Technology, communication barriers, failure, success, commercial pressure, policies.</td>
</tr>
<tr>
<td>Affect</td>
<td>102</td>
<td>Motivation, perception, transparency, volition.</td>
</tr>
<tr>
<td>Cost</td>
<td>92</td>
<td>Budget savings, business models, commercial models, costs, economic models, funding models, government funding, market place, value.</td>
</tr>
<tr>
<td>Alienation</td>
<td>91</td>
<td>Automation, communication, dystopia, humanity, intrusion, policy, privacy, resistance, society.</td>
</tr>
<tr>
<td>Standards</td>
<td>79</td>
<td>Standards, standardization, interoperability, API, IMS, LTI, Caliper, Experience API, xAPI, TinCan, SC36.</td>
</tr>
<tr>
<td>Temporality</td>
<td>64</td>
<td>Duration, initial state, just-in-time, rate, speed, sufficiency, timescale.</td>
</tr>
<tr>
<td>Total:</td>
<td>2111</td>
<td></td>
</tr>
</tbody>
</table>

The coding of the corpus of free text responses indicates that the two key issues which concern the respondents are:

- the pedagogical effectiveness and/or appropriateness of learning analytics interventions
- the socio-political implications of data gathering and of learning analytics methods.
These findings complement the analysis of the individual visions, and largely confirm the conclusions which can be drawn from the individual visions, as we now discuss.

4.4. Overall findings

In this section we draw together the results of the Likert scale analysis, the analysis by visions, and the thematic analysis of the corpus of free text responses. For each of the visions the drivers identified in the responses to the visions were related by the team to policy interventions which would be consistent with the aspirations for learning analytics expressed by the respondents.

We identify six principal findings:

Finding 1: A question mark over the prospects for learning analytics achieving its potential

The response to Vision 3: Learning analytics are rarely used in education was, as one might expect from this population, a resounding rejection. The respondents felt strongly that learning analytics had a lot to contribute to education, and that the opportunity to reap the benefits should not be lost. However, this highly undesirable outcome was seen by many as being feasible, with a slight majority viewing it as being feasible or very feasible. Learning analytics is therefore not seen as an unstoppable trend, but as an approach with great potential which is still at an early and sensitive stage of its development.

This trend was also seen in the responses to other visions. Indeed in only one vision is there a good match between desirability and feasibility. This is Vision 6: Learning analytics systems are essential tools which is seen quite positively in both. In contrast Visions 4, 5, and 8 are very positively rated for desirability, but respondents are much less optimistic that they are feasible. The converse is true for visions 1, 2, 3 and 7, which rated as clearly undesirable, but respondents are concerned that there are real prospects that they will come about. This is indicative of a learning analytics community which has serious doubts about the desirability of many of the potential scenarios for learning analytics, and has low levels of confidence that positive outcomes will be forthcoming.

The drivers for learning analytics associated with this result are:

- Confidence in a successful future for learning analytics
- The opportunity presented by the availability of data and the potential pedagogic benefits of analytics
- Policies and regulations to ensure data privacy

The recommended actions aligned with these drivers are

- Provide support for piloting and the demonstration of pedagogic benefits from learning analytics
- Provide support for research into the efficacy of learning analytics
- Develop alternative certification processes
- Ensure the participation of humans in teaching
- Ensure learning analytics is informed by pedagogy
- Research and promote appropriate pedagogies for learning analytics
- Formulate and implementation of policies and regulations to ensure data privacy
- Institutions should create and apply protocols and policies to govern ethics and privacy (x4)
• Regulatory bodies should act to govern data collection and use, and enforce data privacy policy in tooling

**Finding 2: Policies and infrastructure**

The responses to *Vision 4: In 2025, individuals control their own data* rated it as being very desirable, and a majority of respondents also thought that it was feasible. There is a strong consensus that it is ethically essential to regulate control of users data so as to strengthen the rights of the data subject, and that this is also a necessary step if learning analytics is to be widely acceptable. There were some minority voices which pointed out that this would lead to lost opportunities, and that education institutions already collected a lot of data about learners. This result is also at odds with current practice in learning analytics, and influential current codes of practice published by Jisc and Open University UK.

There was a similarly strong consensus for *Vision 5*, indicating that an open and standards compliant infrastructure for learning analytics is essential in order to make progress. There were almost no dissenting voices to this vision.

These results relate to two strong drivers for the future of learning analytics:

• Availability of a shared open infrastructure for learning analytics
• The creation of a strong regulatory framework to govern data ownership, collection and use.

These drivers are aligned with recommended actions for governments, agencies and the Commission to support

• Institutions should create and apply protocols and policies to govern ethics and privacy
• Regulatory bodies should act to govern data collection and use, and enforce data privacy policy in tooling
• Develop of common data models, specifications, standards and policies.
• Develop an open infrastructure. Respondents mentioned potential partners in this work, including Apereo and SoLAR.
• Support international and national collaboration between institutions

**Finding 3: A consensus on pedagogy**

In coding the free text responses, ‘pedagogy’ was the most frequently used tag, by a substantial margin (see Table 4: Number of applications of codes in the 8 visions, below). In broad terms the pedagogic approaches which were favoured by most respondents in their comments could be characterised as constructivist and teacher led, rather than being focused on competences and mastery of content. Doubt was also expressed about the metrics used to assess teaching and learning. There was a consensus that it is essential for human beings to remain at the centre of the teaching process, and that learning analytics should not imply automation of teaching and learning. The ‘pedagogy’ tag can be associated with the ‘validity’ tag (the fourth most used), which was used to indicate those comments which questioned the pedagogic effectiveness of learning analytics interventions, or stressed that this should be demonstrated and disseminated. Together the ‘pedagogy’ and ‘validity’ tags accounted for more than a quarter of the codes applied.

This trend was confirmed by the response to *Vision 7*, which was the least popular of all the pedagogic approaches to learning analytics that were presented to respondents. Objections centred...
on the proposal that “Learners now spend most of their time working with analytics-driven systems, and the role of teachers has been reduced”, which was rejected by most respondents, often strongly so. This is consistent with the results for other visions, in which many respondents also place great importance on face-to-face communication with teachers. It is interesting that respondents from the workplace were stronger in their opinion that this approach was not feasible, even though one might expect computer based training to be better established in that sector. There were surprisingly few references to economic factors, even though this is a key aspect of the replacement of teachers by machines. The most positively viewed pedagogic scenario was that in Vision 8, in which collaborative inquiry based learning was supported by analytics.

The consensus was not unanimous, and some respondents stressed the potential benefits that automated teaching.

These results relate to the following drivers

- Alignment between the pedagogies instantiated in learning analytics methods and the context in which they are deployed
- Enthusiasm, or even just acceptance, from the teachers who will be using learning analytics systems.

These drivers align with the following actions:

- Fund and carry out research into the pedagogic use of learning analytics.
- Build trust and collaboration between educationalists and technologists
- Provide support for research into the efficacy of learning analytics, and into the appropriate pedagogies for learning analytics
- Provide support for piloting and the demonstration of pedagogic benefits from learning analytics

**Finding 4: Power, ethics, and data ownership**

Issues of social and political power, ethics, and ownership are central factors to the future of learning analytics. The cluster of codes ‘power’ (the second most applied code), ‘privacy’, ‘regulation’ and ‘ethics’ together accounted for more than a third of the codes applied. While the codes can be clearly distinguished, but have a common thread in the results. ‘Power’ was related to both the exercise of power to obtain data, and the use of data analysis to reinforce power. ‘Privacy’ and ‘regulation’ both principally related to the desire among respondents for data subjects to have more control over the data which they generate, and the uses to which it is put. Ethics, similarly, very often related to the management of data. Together these codes indicate a widespread concern that the benefits of analytics may be threatened by a reaction against intrusive collection of data, and inappropriate use of the results of analysis.

These results of the coding are reflected in the responses to the visions, in which every vision received comments from users that mentioned these issues.

These results relate to the following drivers:

- Social and political consensus on the appropriate collection and use of data.
- Trust in the responsible collection and use of data.
The actions aligned with these drivers are

- Development of policies and systems that support the control of data by data subjects.
- Promotion of transparency and accountability in the collection and use of data.
- Institutions should create and apply protocols and policies to govern ethics and privacy.
- Regulatory bodies should act to govern data collection and use, and enforce data privacy policy in tooling.

**Finding 5: Disagreement between sectors, and between different groups of respondents**

The population for the study was divided into three sectors (school, workplace and higher education), and two sources of respondents (invited experts and those who replied to the web link).

The differences between these five groups are not very large, but are worth attending to. To give some examples:

- Vision 1 is clearly aimed at the school classroom, and the results show that respondents from schools were substantially more positive in their assessment of the vision than were those from higher education or the workplace. Almost twice as many respondents to the web link found the vision to be ‘very undesirable’ than did invited experts.

- For Vision 5 for both the School sector and the Workplace sector the largest number of respondents indicated that the vision was rather infeasible (2). In Higher Education, on the other hand the largest number of respondents thought it feasible (3), with a large number asserting that it was very feasible (4). The fact that there were many more respondents from Higher Education than other sectors means that this view prevails in the overall results. But it would be wise to take note of the greater barriers that are perceived to open learning analytics in schools.

- Vision 6 was seen as markedly less desirable and feasible by respondents from the schools sector. Similarly, respondents who accessed the survey through the web link found the vision to be substantially more feasible than did the invited experts.

These differences suggest that there may be a gap in understanding between experts and practitioners on the ground. The possibility should be considered that a socio-technical elite is proposing systems and methods that are not entirely welcomed by practitioners in the field. It should be remembered that the respondents were all either selected or self-selected enthusiasts for learning analytics, and this effect might be considerably larger in the wider community.

The driver indicated by this finding is:

- Alignment of the research and development interests of the learning analytics community with the interests and priorities of those whose focus is the day to day activities of teaching and learning.

The action aligned with this driver is:

- Support research into the reality of learning analytics in context.
- Fund coordination activities which reach across the communities of practice.
Finding 6: Technology
Respondents seemed satisfied with the technology which is already available, and confident that it will continue to develop.

This result relates to the following driver:

- Continuing technological innovation

The results suggest that no policy intervention is required to maintain the pace of innovation in the underlying technology used by learning analytics.
5. Future Steps

We have found it fascinating to engage with the learning analytics community in carrying out this study. We believe that policy makers will find the results to be very relevant, and that the community which has contributed to the study will be very interested in seeing the reflection of its judgements on the future of learning analytics.

We also believe that the data which we have generated is a rich resource which can be further mined. In particular there are statistical methods which can be applied to the data which may result in additional insight, in particular in the comparison of the views of different groups of respondents. Further analysis of the corpus of free text may also be worthwhile, perhaps using statistical tools.

We have already held a number of consultations with stakeholder concerning the Visions of the Future study. This work will be continued at LAK, where a panel about the Visions of the Future study has been accepted. These activities are important in two ways. Firstly, they reflect back judgements of the future of learning analytics to the community that generated them, providing the opportunity to test that the population included in the study is indeed representative of the full range of actors involved in learning analytics. Secondly, the conclusions are at a higher level of abstraction than the visions which stimulated the responses, and they propose an interpretation of the implications of the responses. It is important to contrast this interpretation with the judgements of the learning analytics, both to expose inconsistencies between participants’ judgements about learning analytics in different contexts, and also to critique the studies’ interpretation of the data.

Following the LAK conference the team intended to build on these consultations, and on further analysis of the corpus, in the writing of a journal paper which will set out the final conclusions of this work within the LACE project. The paper will be ready for submission by the close of the project.
**Reference list**


Horn, M., 2014. inBloom’s Collapse Offers Lessons For Innovation In Education. *Forbes*.


Appendices

Appendix 1. Graphical representation of the Likert scale results
Charts were prepared showing respondents responses to the Likert scale questions on the feasibility and desirability of each vision. The charts are as follows:

1.1 Personal information

![Figure 10: Respondents knowledge of learning analytics](image)

![Figure 11: Respondents by sector](image)
1.2 Desirability and Feasibility: all data

Figure 12: All desirability data

Figure 13: All feasibility data
1.3 Desirability by sector

Figure 14: Desirability data charted by sector
1.4 Feasibility by sector

Figure 15: Feasibility data charted by sector
1.5 Desirability by source of respondents

Figure 16: Desirability data charted by respondents (responded to direct/general) invitation
1.6 Feasibility by source of respondents

Figure 17: Feasibility data charted by respondents (responded to direct/general) invitation
Appendix 2: Coding summary chart

This chart shows how many times each of the 13 themes appeared in the coding of the SurveyMonkey data. The coding is presented to show the coding for desirability, feasibility and actions for each of the eight Visions that were presented for comment.

Table 4: Number of applications of codes in the 8 visions

<table>
<thead>
<tr>
<th>Vision 1</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>8</td>
<td>12</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>24</td>
<td>15</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Feasibility</td>
<td>4</td>
<td>2</td>
<td>17</td>
<td>6</td>
<td>2</td>
<td>13</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Actions</td>
<td>11</td>
<td>2</td>
<td>10</td>
<td>6</td>
<td>8</td>
<td>1</td>
<td>12</td>
<td>11</td>
<td>9</td>
<td>11</td>
<td>2</td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vision 2</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>6</td>
<td>3</td>
<td>10</td>
<td>2</td>
<td>15</td>
<td>0</td>
<td>26</td>
<td>13</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Feasibility</td>
<td>3</td>
<td>3</td>
<td>19</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>20</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Actions</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>11</td>
<td>8</td>
<td>5</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vision 3</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>9</td>
<td>9</td>
<td>13</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Feasibility</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>12</td>
<td>8</td>
<td>13</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Actions</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>13</td>
<td>6</td>
<td>18</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vision 4</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>9</td>
<td>2</td>
<td>19</td>
<td>30</td>
<td>26</td>
<td>9</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Feasibility</td>
<td>3</td>
<td>3</td>
<td>18</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>8</td>
<td>17</td>
<td>35</td>
<td>13</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Actions</td>
<td>1</td>
<td>2</td>
<td>14</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>12</td>
<td>38</td>
<td>22</td>
<td>4</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vision 5</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>13</td>
<td>2</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>11</td>
<td>23</td>
<td>3</td>
<td>3</td>
<td>18</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Feasibility</td>
<td>3</td>
<td>1</td>
<td>17</td>
<td>15</td>
<td>3</td>
<td>7</td>
<td>6</td>
<td>20</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Actions</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>23</td>
<td>4</td>
<td>12</td>
<td>13</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vision 6</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>20</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Feasibility</td>
<td>1</td>
<td>5</td>
<td>14</td>
<td>4</td>
<td>2</td>
<td>11</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Actions</td>
<td>0</td>
<td>6</td>
<td>11</td>
<td>4</td>
<td>7</td>
<td>1</td>
<td>9</td>
<td>11</td>
<td>4</td>
<td>10</td>
<td>2</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vision 7</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>13</td>
<td>15</td>
<td>5</td>
<td>2</td>
<td>9</td>
<td>7</td>
<td>39</td>
<td>14</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Feasibility</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>11</td>
<td>19</td>
<td>11</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Actions</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>13</td>
<td>14</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vision 8</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>0</td>
<td>6</td>
<td>12</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>33</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Feasibility</td>
<td>0</td>
<td>1</td>
<td>22</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>5</td>
<td>13</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Actions</td>
<td>0</td>
<td>2</td>
<td>12</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>24</td>
<td>8</td>
<td>1</td>
<td>20</td>
<td>6</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOTALS</th>
<th>Affect</th>
<th>Alienation</th>
<th>Complexity</th>
<th>Costs</th>
<th>Ethics</th>
<th>Experience</th>
<th>Pedagogy</th>
<th>Power</th>
<th>Privacy</th>
<th>Regulations</th>
<th>Standards</th>
<th>Temporal</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>91</td>
<td>238</td>
<td>92</td>
<td>132</td>
<td>109</td>
<td>355</td>
<td>313</td>
<td>180</td>
<td>169</td>
<td>79</td>
<td>64</td>
<td>187</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3: Visions of the Future

This Appendix sets out the eight scenarios that were used in the Policy Delphi study. The scenarios were developed by the five authors of this report, each of whom has wide experience of the field of learning analytics. They were then revised and extended in consultation with the whole LACE team, in order to bring in other expertise and perspectives. The visions were intended as provocations that would produce reactions; they were not intended to reflect the views of project members or of the LACE project as a whole.

Each of the eight scenarios begins with a short summary and then briefly contrasts the situation in 2015 with the envisaged scenario in 2025. The body of the scenario sets out this vision, and some of its possible implications, in more detail.

3.1 Vision 1: In 2025, classrooms monitor the physical environment to support learning and teaching

In 2015, learning analytics were mainly used to support online learning. By 2025, they can be used to support most teaching and learning activities, wherever these take place. Furniture, pens, writing pads – almost any tool used during learning – can be fitted with sensors. These can record many sorts of information, including tilt, force and position. Video cameras using facial recognition are able to track individuals as they learn. These cameras monitor movements, and record exactly how learners work with and manipulate objects. All this information is used to monitor learners’ progress. Individuals are supported in learning a wide range of physical skills. Teachers are alerted to signs of individual learner’s boredom, confusion, and deviation from task. Teachers and managers are able to monitor social interactions, and to identify where they should nurture socialisation and cooperative behaviour.

3.2 Vision 2: In 2025, personal data tracking supports learning

In 2015, people were beginning to wear devices such as heart-rate monitors and run-trackers as they went about their daily lives. By 2025, sophisticated sensors can gather personal information about factors such as posture, attention, rest, stress, blood sugar, and metabolic rate. People collect this information about their activities, and feed it into programmes of their choice that provide recommendations on how to act in ways that improve their learning. Learners can download the statistics and data that are associated with successful learning in a certain area. Aligning personal data with these ‘ideal’ sets is claimed to help people to master skills as diverse as swimming, driving, carrying out surgery and passing examinations. Academic stars sell programmes using this data to optimise learning for different ages and courses. Business gurus market similar programmes for topics such as presentation skills and workload management. Some learners create and share their own data analysis programmes, which provide recommendations that often include the consumption of high-energy foods and stimulants. The majority of high-school and university students follow self-monitoring programmes, and discuss the merits of these on social media.

3.3 Vision 3: In 2025, analytics are rarely used in education

In 2015, many people hoped that analytics would be able to improve teaching and learning and the environments where these take place. However, in 2025, it is clear that there are many problems. Courses that are automated by analytics are seen as inferior, and learners have realised that they can game the system. There have been major leaks of sensitive personal data, and it is clear that, even where this has not happened, many companies have misused the data generated by their
analytics. Many governments have ruled that individuals are the sole owners of the data they generate. All use of data for educational purposes now has to be approved not only by the learner but also by new inspectorates. In practice this has meant that use of analytics is restricted to summative assessment carried out by government agencies. A consensus has emerged in educational policy: the move away from learning analytics is not only ethically desirable it is also educationally effective.

3.4 Vision 4: In 2025, individuals control their own data

In 2015, it was not clear who owned educational data, and it was often used without learners’ knowledge. By 2025, most people are aware of the importance and value of their data. Learners control the type and quantity of personal data that they share, and with whom they share it. This includes information about progress, attendance and exam results, as well as data collected by cameras and sensors. Learners can choose to limit the time for which access is allowed, or they can restrict access to specific organisations and individuals. The tools for making these choices are clearly laid out and easy to use. In the case of children, data decisions are made in consultation with parents or carers. If they do not engage with these tools, then no data is shared and no benefits gained. Most educational institutions recognise this as a potential problem, and run campaigns to raise awareness of the both the risks of thoughtless exposure of data, and the benefits to learners of informed sharing of selected educational data.

3.5 Vision 5: In 2025, open systems for learning analytics are widely adopted

In 2015, companies produced a range of learning analytics tools, using different approaches and standards. The algorithms and models that companies use are often protected as intellectual property. By 2025, the ‘open learning analytics’ established by the Open Learning Analytics Foundation has made a more joined-up approach possible. Educational organisations see learning analytics as a central element of their IT provision. They demand control over these tools, how they run and what they are used for. The tools they select, although they come from different providers, use open algorithms and share data according to an agreed set of standards that facilitate transparency and independent validation. A set of well-tested, accessible and standardised visualisation methods is commonly used, so that learners and teachers can confidently use a range of tools. Institutions can easily work with a range of providers to design learning analytics systems that support their strategic vision.

3.6 Vision 6: In 2025, learning analytics systems are essential tools of educational management

In 2015, companies were beginning to develop systems to recommend resources and to predict outcomes. By 2025, these systems are highly developed. A wide range of data about learner behaviour is used to generate good quality, real-time predictions about likely success. Learners, teachers, managers and policymakers all have access to live and accurate information about how well a learner is likely to do. Learners and teachers plan their work on the basis of reliable tools that can produce detailed and personalised recommendations about what should be done to achieve the best learning outcomes. A growing industry offers services to institutions and individuals, advising on how to respond to predictions generated by analytics, and how to take appropriate action in the light of recommendations. Accurate predictive information enables managers and policymakers to expand or contract learning provision before success or failure is evident: you don’t have to wait to see if a course is booming or failing, with funding changes happening quickly.
**3.7 Vision 7: In 2025, most teaching is delegated to computers**

In 2015, people were beginning to assemble datasets that could represent learner’s activities. By 2025, these are used on a large scale in teaching, and this has led to the development of enormous datasets containing information about hundreds of thousands of learners. Analysing in detail the progress of such a wide variety of learners has made it possible to provide reliable evidence-based recommendations about the most successful routes to learning, as well as identifying the learning materials and approaches that are most suitable for each individual at each point in their progress. These recommendations are better informed and more reliable than those that can be produced by even the best-trained humans. Learners now spend most of their time working with analytics-driven systems, and the role of teachers has been reduced. The evidence generated by the use of these systems drives education policy.

**3.8 Vision 8: In 2025, analytics support self-directed autonomous learning**

In 2015, learners in educational institutions and in businesses had to follow a curriculum developed by others. In 2025, they create groups that work together to decide their learning goals and how to achieve these. A ‘Learning Trajectory System’ uses analytics to support information exchange and group collaborations, and learners receive support from mentors, rather than teachers. Activity towards a learning goal is monitored, and analytics provide individuals with feedback on their learning process. This includes suggestions, including peer learners to contact, experts to approach, relevant content, and ways of developing and demonstrating new skills. Formative assessment is used to guide future progress, taking into account individuals’ characteristics, experience and context, replacing exams that show only what students have achieved. Texts and other learning materials are adapted to suit the cultural characteristics of learners, revealed by analysis of their interactions. As a result, learners are personally engaged with their topics, and are motivated by their highly autonomous learning. The competences that they develop are valuable in a society in which collection and analysis of data are the norm. There is also convergence between the learning activities of the education system and the methods used by employees to develop their knowledge and skills.

Appendix 4: Information for participants

**4.1 Pre-survey**

*On entering the survey, the participants were presented with the following information:*

**Welcome to LACE’s visions of the future study**

The aim of this study is to consider views on the future of learning analytics in terms of what is desirable, what is feasible and the obstacles to making what is desirable happen. The LACE Project has created eight visions of the future of learning analytics. Each vision illustrates a different aspect of the way that learning analytics could transform our lives by the year 2025. The study intends to draw out differences of perception and vision from yourself and a wide group of stakeholders, researchers and practitioner experts on learning analytics.

In the questionnaire you will be presented with a short vision statement, and asked if you find this vision to be desirable and feasible, and what would be needed to bring it about.
There are some questions for which an answer is required, marked with an asterisk (*). If you feel you do not have the knowledge to provide an informed response please select the answer "I do not feel qualified to respond".

To give you time for full consideration of your free text responses, you will initially be asked to give your views on three visions.

When you have finished these, you have the option to stop, or you can continue, and, of course, we will be very grateful if you can do this. We estimate that it will take you 60 minutes to respond to all eight visions. You can stop at any time and return to restart at the point you finished.

If you finish all eight visions, you will be invited to add your own visions, if you think that anything is missing.

The results of the study will be published as a LACE Learning Analytics Review paper. The information which you provide in this survey will be anonymised before publication. We are however, requesting that you provide a little information about your knowledge of the area. We would also be grateful for the opportunity to contact you if we have any queries or further questions in relation to your comments, and so we request that you provide your email address when you finish answering. However, if you would prefer to answer anonymously, that is also possible.

In recognition of your participation we will send you an advance copy of our “Visions of the Future” papers provided you give us your email address (you will have an opportunity to this on a later page).
If you have any questions about the study please contact Andrew Brasher: andrew.brasher@open.ac.uk.

Please note: This survey is using Survey monkey and any information you enter will be stored temporarily in the US. By taking part in the survey you are consenting to any information that can identify you as an individual being stored in this way.

4.2 Post survey
ON LAST PAGE OF SURVEY THE PARTICIPANTS WERE ASKED:

We may want to quote your responses to this survey anonymously in reports and publications. Please let us know if you agree that we can.

☐ Yes, you can quote my responses anonymously in reports and publications
☐ No, you cannot quote my responses anonymously in reports and publications
About

Version History

<table>
<thead>
<tr>
<th>Date</th>
<th>Notes</th>
<th>Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Jan 2016</td>
<td>Initial draft</td>
<td>Dai Griffiths, UOB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Andrew Brasher, OUUK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rebecca Ferguson, OUUK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Doug Clow, OUUK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Li Yuan, UOB</td>
</tr>
<tr>
<td>29 Jan 2016</td>
<td>Version for internal review</td>
<td>Dai Griffiths</td>
</tr>
<tr>
<td>04 Feb 2016</td>
<td>Annotated reviews</td>
<td>Rebecca Ferguson, Maren</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scheffel, Hendrik Draschler</td>
</tr>
<tr>
<td>09 Feb 2016</td>
<td>Final version</td>
<td>Dai Griffiths</td>
</tr>
<tr>
<td>09 Feb 2016</td>
<td>Cleared for submission to the</td>
<td>Hendrik Drachsler, Maren</td>
</tr>
<tr>
<td></td>
<td>EC</td>
<td>Scheffel</td>
</tr>
</tbody>
</table>

About this document

(c) 2016, Dai Griffiths, Andrew Brasher, Doug Clow, Rebecca Ferguson, Li Yuan

Licensed for use under the terms of the Creative Commons Attribution v4.0 licence. Attribution should be “by Dai Griffiths, Andrew Brasher, Doug Clow, Rebecca Ferguson, and Li Yuan, for the LACE Project (http://www.laceproject.eu)”.

For more information, see the LACE Publication Policy: http://www.laceproject.eu/publication-policy/. Note, in particular, that some images used in LACE publications may not be freely re-used.

About LACE

The LACE project brings together existing key European players in the fields of learning analytics & educational data mining who are committed to building communities of practice and sharing emerging best practice in order to make progress towards four objectives.

Objective 1 – Promote knowledge creation and exchange
Objective 2 – Increase the evidence base
Objective 3 – Contribute to the definition of future directions
Objective 4 – Build consensus on interoperability and data sharing

http://www.laceproject.eu
@laceproject
http://lanyrd.com/profile/laceproject/
https://www.linkedin.com/groups/Learning-Analytics-Community-Exchange-LACE-8133802

This document was produced with funding from the European Commission Seventh Framework Programme as part of the LACE project: grant number 619424