The Formative Assessment of College English Learning Aided by Visual Analytics

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Abstract. The concept and practice of formative assessment have been well-recognized and playing increasingly important roles in the field of College English in recent years. One of the distinctive features of formative assessment is that the primary purpose of it is to promote learning, rather than assess its result. To achieve the goal, we must first of all make full use of the information collected in the assessment process, to provide the learners with meaningful and positive feedback. There are various ways to transform information into data, and data into knowledge that can be well-understood by human beings (the learners). Until now, numbers and tables are the most common way of presenting this knowledge. One of the drawbacks of numbers and tables though, is that they can only convey a very limited amount of “understandable” information. By contrast, examples and experimentation seem to suggest that visual analytics may be a better and noteworthy approach to presenting the knowledge of formative assessment.

Introduction

The latest reform in the field of CE (College English) education (distinguished from the specialized learning of English language and literature) in this country started in the end of the 20th century. One of its achievements is the introduction of the concept and practice of formative assessment. As stated in the, the assessment of learning should include both formative assessment and summative assessment [1]. Another very important document to be published, the Guideline on College English Teaching, also points out that appropriate relations should be retained between formative assessment and summative assessment, that a summative assessment focusing on the result of learning should be combined with a formative assessment aiming at the promotion of learning. The assessment system of CE is supposed to be able to bear such roles as guiding, encouraging, diagnosing, improving, testing, counseling and decision-making, thus promoting the construction of the curriculum and the students’ learning [2]. The ultimate goal of summative assessment is to measure the result of the students’ learning, while that of formative assessment focuses on the process of learning and to provide the learners with timely and meaningful feedback.

To achieve the purpose of providing meaningful feedback, information or data collected in the process of assessment is of vital importance. This aim is seemingly easy but actually tricky, because the value of raw information or data is only potential and underlying prior to the mining and analysis process. That’s to say, data can only be utilized until they are transformed into knowledge. The presentation of knowledge usually comes in the form of tables combined with text description. However, there have already been applications and researches of visual analytics in the domain of information science in recent years. As a result, the efficacy of knowledge presentation has been greatly improved, which inspires us into thinking that similar consequences are also likely if appropriate visual analytic methods are used in the formative assessment of CE learning. Unprecedented knowledge will be derived from the information and data collected, and our experience of data reading will also be improved greatly.
Attribute Analysis of CE Formative Assessment Data

Until now, many urgent problems persist in the formative assessment of CE in China’s colleges. One of the most prominent is that a clear line has yet to be drawn between formative assessment and summative assessment in practice. According to some researchers, in some colleges, there are virtually no difference between the so-called formative and summative assessment [3]. In other words, the present-day formative assessment of CE is still in the stage of “Assessment of learning”, with the primary role of measuring the result of learning [4], far from the ideal phase of “Assessment for learning” [5, 6].

It is not that we persist in the dominance of summative assessment but that the effective feedback of formative assessment in theory cannot be realized easily in practice. One of the important reasons of this difficulty is that the assessment data are characterized by the “4 V” of big data.

Volume

Volume is not the sole standard by which to judge what data can be classified as big data. The main purpose here is not to argue whether CE formative assessment data is big data or not. The point I want make is that this data is already out of the control of CE teachers and curriculum managers. The volume of this data has already been great, and more data are being reproduced. A direct consequence is that a large amount of information is not recorded, not converted, not analyzed, thus is unlikely to produce timely and effective feedback.

Variety

Information or data derived from CE formative assessment comes in various forms. To begin with, in terms of learning content, there are the basics of language such as vocabulary, grammar, discourses, the skills of listening, such as speaking, reading, writing, and translation; and there are also culture and disciplinary contents. Besides, learning takes place in all kinds of environments, such as regular classroom study, and internet-based blended learning, etc. There are individual and personalized learning, group learning, and collaborative learning. Thirdly, the subjects and objects of assessment can be different. For example, it can be the teachers’ assessment of the students or vice versa; it can also be the students’ or the teachers’ assessments of their peers. Furthermore, feedback can be provided through various channels. It can be simultaneous oral feedback, or asynchronous written and online feedback. Finally, the above-mentioned information or data may come in the forms of texts, numbers, graphics, icons or animations etc.

These various types of information or data make recording, classification, conversion, and analysis extremely difficult, requiring scientific methods to guarantee authenticity and efficacy.

Velocity

It goes without saying that velocity plays vital roles in formative assessment. Because if assessment information is not converted into data, and converted data is not followed by further mining and analysis, thus cannot provide feedback of any kind, then this data is dead data, and dead data can by no means promote learning.

Value

Assessment data is only valuable when it is converted into knowledge, mined, analyzed, its regular patterns found, and contributing to the improvement of curriculum management and the students’ learning. However, because of its immense volume and variety, valuable information is sparsely and unevenly distributed, making these processes extremely difficult.
Visual Analytics and Its Application in CE Formative Assessment

A Brief Summary of Basic Concepts and Applications of Visual Analytics

Studies have indicated that visual signals constitute around 80 percent of the information that we human beings get from the environment [7, 8]. A case in point in the domain of computer and information science is the Windows graphical operating system. It began to replace DOS in 1980s and is still the most popular operating system on PCs. Of course, DOS is still running behind the scenes. The advantage of Windows is its visualization and easy to use.

Visual analytics is the science and technology that enable users to analyze and examine large-scale and complex data via interactive and visualized interfaces [9]. It is a new research trend combining the study of theories in science/information visualization, human-machine interaction, cognition science, data-mining, informatics and decision-making [10]. Visual analytics of data, to put it simply, is to automatically analyze and mine data, to utilize information visualization user interface and human-machine interaction approaches and technologies, and to integrate the computing capacity of the computer with human cognitive skills to gain insights into large-scale and complex data. The first international annual summit in this field, the IEEE Conf. on Visual Analytics Science and Technology, or IEEE VAST for short was held in 2006. In the past decade, theoretical and practical researches of data visual analytics have been carried out in the fields of the Internet, social networking, urban transportation, journalism and broadcasting, business intelligence, meteorology, economics and banking etc.

Experiments of Visual Analytics in CE Formative Assessment

A. Limitations of Simple Data Report

The process of formative assessment generally includes: assessment design, assessment implementation, data collection, data analysis, summary, report and feedback, among which data report is one of the most crucial as it has profound effects on the effectiveness of feedback.

Figure 1 is an example of the formative assessment results of 5 students.

<table>
<thead>
<tr>
<th>Name</th>
<th>ID NUM</th>
<th>Listening</th>
<th>Reading</th>
<th>Writing</th>
<th>Speaking</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lee</td>
<td>201822419001</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Chang</td>
<td>201822419002</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Lu</td>
<td>201822419003</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>26</td>
</tr>
<tr>
<td>Yang</td>
<td>201822419004</td>
<td>7</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>31</td>
</tr>
<tr>
<td>Xu</td>
<td>201822419005</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>20</td>
</tr>
</tbody>
</table>

Figure 1. Simple Assessment Data Report.

It can be easily noticed that this figure can only report simple results of a period of learning. Reading this report, the students tend to focus their attention only on the total score. Other information, such as their respective listening, reading, writing and speaking performance, is too complicated to be read with human eyes. In consequence, the students can only get limited positive feedback from this report, which is not what formative assessment is supposed to achieve.

According to the “feedback — rectification” theory of Benjamin Bloom (1986), the fundamental goal of formative assessment is not only to measure and record the result of learning, but to provide learners at different levels with timely and positive feedback, because only positive feedback can produce positive learning results. In the meantime, the purpose of formative assessment is also to help the students find and correct mistakes [11]. Hence, if assessment data analysis only serves to report the result of learning, students at different levels will not be able to receive individualized and positive feedback.
In order to improve the efficacy of feedback, we need to change the way in which data is reported.

**B. Preliminary Visualized Analysis of Multidimensional Assessment Data**

As can be seen from the above example, formative assessment data is often multidimensional. For the convenience of direct, effective observation and perception, the origin data table can be transformed into a more visualized perspective view diagram (Fig. 2).

![Figure 2. Visualized Perspective View Diagram.](image)

By comparison, one of the advantages of this diagram is that the students will pay less attention to the total score. For example, student Xu will not feel embarrassed because his/her score is at the bottom. More importantly, this diagram has shifted people’s attention from the total score to the more meaningful details. The students may be fascinated by the unbalanced development in terms of listening, reading, writing and speaking. For example, we can easily see that even though the performance of student Chang looks impressive, his listening and speaking obviously lags behind reading and writing. On the other hand, there are no eminent rises and falls in student Yang’s diagram, consequently, he/she scores the highest in total among the five. All these are likely to offer the students guidance for their subsequent learning, thus providing more beneficial and positive feedback.

**C. Preliminary Visualized Analysis of Dynamic Assessment Data**

Dynamic assessment data is needed when the range of data-collecting has been extended in order to give a more objective assessment of the students’ learning during a certain period of time. For instance, we may put data of two or more assessments in one data table for comparison. Here, we are not saying that desirable results may come out automatically by simply putting data together in one data table. Please compare the different effects of Fig. 3 and Fig. 4.

![Figure 3. Simple Comparison of Two Sets of Assessment Results.](image)

Fig. 3 is an example of simple comparison of two sets of assessment results. We can see that by putting more original data together, we are not communicating more but actually few effective messages. The bigger the data, the more difficult it is for the human eye to retrieve information from it. This may suggest that if we want to achieve better or even unexpected results, data analysis approaches have to be employed.
Based on the table illustrated in Fig. 3, we can get a perspective view in Microsoft Excel (Fig. 4). The students’ listening, reading, writing, speaking and total performances of the two assessments are represented by bars of different colors. By observing and comparing these bars, we can safely draw the following conclusions: (1) All these five students are making progress in listening, writing, speaking and total performances; (2) Although the performance of student Xu seems less impressive, he/she makes the greatest progress; (3) Among the five students assessed, only student Lu is not making progress in reading.

In brief, compared with Fig. 3, Fig. 4 can convey more and effective messages, what’s more, the feedback of Fig. 4 is positive.

**D. Selective visual analysis of complex data**
From the above comparison and analysis, we can easily find that the bigger the data, the more complicated the case, the more difficult it becomes for the human eye to get valuable information from the raw data (Fig. 5).

Before complex data is analyzed, data selection is generally required. By data selection, we mean that scientific procedures and disciplines have to be observed so that data can be selected according to our special needs. The purpose of data selection is to satisfy our specific needs and to improve feedback efficiency.

In Fig. 5, the maximal value of totals is 40, while that of the other sub-items is 10, and it does not make sense to observe the value of totals, so first of all we decide to exclude totals in our analysis.

Next, there is the method selection, which means we have to decide on what purpose we want to achieve and what visual analytic methods we think is appropriate. Fig. 6 is an example of Microsoft Excel radar chart (also called spider chart). Different from data tables, curves or bar charts, a radar chart can better satisfy our specific needs, illustrating logical relationships hidden in complex multidimensional data of different periods.

In Fig. 6, apart from the value of totals, all other sub-items are involved in the analysis. It vividly depicts the general trend of these three assessments: the listening, reading, writing and speaking data of these five students are represented by five multilateral figures, and these five multilateral figures are not regular and they are not in the center of the diagram, instead, they are moving towards the bottom left. This trend is also eminently illustrated by the 0 point of the coordinate axis. The bottom
Of course, if we want more specific, detailed information, we may narrow down the scope of data selection. For example, we may want to focus on just one student or one particular item at a time.

Conclusion

The success of CE education and reform is closely associated with the formative assessment of CE learning, while the effect of CE formative assessment is determined by the extent of feedback it provides. Positive feedback does not mean to simply offer the students raw data, because this unanalyzed raw data is virtually unreadable, incomprehensible to most students. The simple examples employed in this essay intend to exemplify the application of visual analytics in CE formative assessment. Visual analytics can make data readable and accessible, thus improving the effectiveness and feedback of formative assessment.

However, prior applications and researches of visual analytics are only seen in fields other than the formative assessment of CE. There may be errors, misconceptions in this piece of pioneering work. Criticisms, suggestions are welcomed. Besides, in the actual settings of CE education, formative assessment data can be more complicated. There may be better, more visualized, more scientific, more effective methods to analyze and report data. All these are awaiting further and far-reaching studies.

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