

Collaborative online annotation of musical scores for eLearning using A.nnotate.com

Christina Anagnostopoulou and Fred Howell

Department of Music Studies, University of Athens, Athens, Greece

Textensor Limited, Edinburgh, Scotland

chrisa@music.uoa.gr, fred@textensor.com

Abstract

In this paper we explore the use of a collaborative online annotation tool for enhanced teaching and research of music analysis in higher education. Manual annotation of printed scores on paper has long been the foundation of music analysis. However, collaboration between music analysts in different countries and discussions on a specific piece under analysis has always been problematic. Moving the process online offers the possibility for sharing and discussion with a group of students or researchers; more interactions; simpler publication; and a more permanent and readable record of analyses than is possible with paper methods.

A.nnotate.com is an online web2.0 service designed for discussing documents; it lets several people attach notes to highlighted text or figures to a single copy of document using a web browser. Scores can be uploaded in PDF format and annotated in a web browser with no software installation. New comments can be added by highlighting text or particular notes or phrases of the score. Tags / keywords can be added to comments to help classify particular musical phrases; depending on the type of analysis. In this case these can be motivic (e.g. 'theme 1'), harmonic ('C minor'), structural (section A), paradigmatic (class 1), and many more. Other students can reply to any comment, allowing a detailed discussion to occur at a precise point in the score.

To investigate how online annotation can be used as an eLearning tool for teaching music analysis, we ran an analysis experiment using A.nnotate with a class of 16 undergraduate music students at the University of Athens. We created 4 groups of 4 students collaborating on the same score, and instructed them to annotate the primary motives and their transformed occurrences, main sections, as well as major key changes.

We found that the main benefits of online annotation were: ability for students to work together on a score without having to be in the same place; having a permanent and readable record of the analysis; an easier way for students to compare their work with analyses done by the lecturer and other groups of students, leading to more discussion; an enjoyable way for students to collaborate on a university assignment and learn from each other. We plan on using the tool in future classes for discussing research papers in addition to scores.

Keywords

annotation, e-Learning, web 2.0, collaboration, discussion, music, analysis, higher education

1. Introduction

Music Analysis is one of the fundamental subjects in any music or musicology degree curriculum in higher education. The discipline of music analysis studies pieces of music, either individually or as a collection, and in its formal side it usually consists in breaking down a piece of music to its components, and looking at relations between these components. Components can be small units, such as notes or chords, or longer constituents such as motives, phrases, entire passages, or even whole sections. Most formal methods are interested in the principles of repetition, variation and transformation of previously heard material in a piece of music, devices which also give a piece its cohesion and coherence [1].

There are various types of analytical methods: traditional morphological analysis, motivic [2], semiotic [3], Schenkerian [4] and others. In recent decades, computational music analysis, also based on the above formal methodologies, has become prominent in the field [5].

The vast majority of work in music analysis concentrates on studying the written form of music, that is the *music score*. Music analysts look for repetitions, how the musical material is presented through the piece, how it is varied or transformed. Rhythmic patterns play a major role in identifying constituent structures, as well as other musical parameters including intervals, melodic contour, tempo, harmonic relations and musical texture.

In a music analysis education setting, students have to learn how to identify and name these units and constituent structures that make up the score, and look for relations between them. They especially learn to identify similarities and categorise constituents according to similarity criteria (for example, name a specific chord, name a section such as “recapitulation”, study the varied occurrence of a motif, and so on). A multiplicity of views is encouraged, and students are asked express their opinions, based on supporting arguments. The exchange of opinions and discussion, which is always done with the music score as a point of reference, proves to be fruitful and enhances the learning experience.

In many disciplines, teachers have started using web 2.0 eLearning tools such as blogs and wikis for enhanced group collaboration and discussion around plain text. Recently web tools have advanced to the point where students can now annotate and discuss complex scanned PDF documents such as music scores online, all using a familiar web browser interface without needing to install software. As far as general eLearning for music is concerned, there have been various initiatives and projects, including [6], [7] and [8].

The next section outlines the motivations for making music analysis an online collaborative activity for students. We then describe the features of the a.nnotate system which make it suitable for discussing scores online, and document the feedback gained and lessons learned from using it for a collaborative music annotation task with several groups of university music students.

2. Aims and motivation for online music analysis in research and teaching

Music analysis currently often starts with hand-written notes on photocopies of music scores. Moving the process online offers a number of potential collaboration benefits, including:

- More readable comments, referring to exact places on the score
- Possibility to share notes with other colleagues, who are not necessarily at the same location
- Possibility to respond to other people's notes, thus initiating discussions
- Providing permanent, readable and printable analyses
- Easy access to analyses by third parties

Collaborative research initiatives in music analysis, since they are almost always based on a score, have suffered in the past because it is not easy to send annotated scores back and forth, particularly where a group of collaborators need to give their feedback on the same copy. Online annotation systems could be extremely useful for a discipline in which comments and analyses are tied to particular places in the music score.

In an eLearning context, a number of additional potential educational benefits apply [9, 10]:

- Encouraging student initiative and student-based learning
- Exchange of opinions and appropriate argumentation teaches students how to have appropriate academic discussions and accept a diversity of approaches
- The process helps students learn from each other
- From an emotional perspective, the experience is fun and students are more motivated
- The teacher can participate in discussions by asking questions, pointing out interesting aspects, giving feedback if needed, and monitoring the whole process.

To investigate whether such benefits are realised in practice, we tried using the A.nnotate.com system with a class of undergraduate music analysis students to discuss a number of scores online. The next section describes A.nnotate, followed by the experiment and its results.

3. The A.nnotate.com system

A.nnotate.com is an online service designed for adding notes and discussions on documents online [11, 12]. Users of the system can upload documents in PDF or Word formats, and then highlight particular phrases or regions of an image and write a comment. Comments can be displayed as draggable 'postits' above the document, in the right margin, or as footnotes. All comments and highlighted text are added to a personal, searchable index, which makes it easy to return to the precise place in a document later. Notes can also be added to a private 'snapshot' copy of any web page, which is useful for web research.

Documents are initially uploaded to a user's private area and assigned a secure access code; a link to the document can be sent out by email to invite other users to view and annotate the same copy online. This makes for easier collaboration as notes can be viewed in context. Invited users can click on any note to attach replies, turning a note into a threaded discussion.

A.nnotate.com was originally designed to help researchers collaborate on research papers (see [13]), but its support for annotating PDFs makes it possible to use it also for collaborating on music scores.

In addition to writing plain text comments, it is possible to add tags or keywords to notes. Such tagging or 'folksonomy' systems have become popular for classifying web pages, blog posts and images (e.g. the delicious.com social bookmarking service, and the flickr.com photo sharing site). Tags on notes and replies can be used to attach semantic information to parts of a piece (e.g. 'key change'); and for collaboration they can also be used for workflow management. One student can tag their note 'query' or 'question' and another can reply and change the tag to 'resolved'.

A.nnotate compared to live screen sharing / web conferencing tools

A.nnotate is not typically used for real-time discussion of a document; the lecturer uploads a document, sends out a link to a group of students, and they read and add comments and replies in their own time, over a period of days or weeks. The comments and discussion form a permanent record, with all notes dated and signed by the authors. This is in contrast to the usage scenario of web conferencing and screen sharing tools (such as webex [19] and gotomeeting [20]) where all participants need to be present at the same time, and comments are more ephemeral.

Features for enhancing group interaction

A.nnotate includes a number of features for enhancing group interactions. Each student gets a personal Home page which includes news of latest notes written by other people; email notifications can be enabled to send an email as soon as someone else replies to one of your comments. Sharing a document with another student is as simple as emailing a link. Such collaboration features are very appealing to students already familiar with web2.0 systems such as Facebook for discussing online with friends.

Other web annotation systems

Many other annotation systems have been developed or proposed; in 1945 Vannevar Bush published a description of a hypothetical memory extension machine or 'Memex' [14] which would allow annotations and links to be added to documents; wikipedia [15, 16] maintains a page listing a number of web page annotation services such as Diigo [21], and Fleck [22] but these are not suitable for annotating music scores scanned into PDF.

Some recent online word processing services have been launched, including Google Docs [27] and Adobe Buzzword [25] but neither supports annotation of uploaded PDFs. Apple's recent launch of an online version of iWork [26] allows review and annotation of an online copy of a document, but does not support uploaded PDFs either, and is restricted to Mac OSX users with a copy of the iWork software. The Adobe Acrobat suite [28] does support PDF annotation and would be a possible alternative to using A.nnotate.com, but it requires each document uploader to license and install a copy of Acrobat so software licensing issues might limit its use in education.

Details of the A.nnotate.com service

The A.nnotate.com service is run by Textensor Limited [1]; anyone can sign up for a free account and upload documents. If the free allowance is exceeded, extra credits can be purchased to allow more documents to be uploaded. In addition, the software can be installed in-house on a university / school server for unlimited use by students and staff.

To use it, students simply need a standard web browser; there are no additional software or plugins to install. It works with IE, Firefox and Safari on Windows, Mac OSX and Linux. It is currently being used for a wide variety of educational uses apart from discussing music scores, including building up a shared annotated index of research papers; extracting and tagging text in documents for database curation tasks, and as a component for enhancing existing virtual learning environments, content management systems and wikis. A web services API is available for A.nnotate [18] which allows it to be integrated with other e-Learning web applications.

4. The experiment

The experiment was conducted remotely with students working on their computers using their home internet connections. Sixteen undergraduate students of the Department of Music Studies at the University of Athens participated in the study. They were divided into four groups of four students each, and each group was given a different piece to analyse:

- Group A analysed Mozart's Piano Sonata KV576, First movement
- Group B analysed J.S. Bach's 6th Cello Suite, Polonaise and Bourrée
- Group C analysed Mozart's Piano Sonata K284, Theme and Variations
- Group D analysed J.S. Bach's Cello Suite in C Major, Sarabande, Bourrée and Gigue

The scores given already had some questions and annotations by the instructor, some of which were intentionally wrong, such as wrong key name and form. These mistakes were made on purpose to prompt reactions by the students and get them engaged with the task at hand.

Students were told to comment on as many of the points below as possible:

1. harmonic relations, major chords, modulations, and cadences
2. motives or subjects, their recurrences, variations and transformations
3. substantial changes in the musical parameters, such as a change in texture, different type of melodic movement, changes of tempo, and others
4. main sections and their functions in the piece as a whole

The four music scores were scanned in PDF format, and uploaded by the instructor to their a.nnotate account. The instructor then sent invitation URL links by email to students, according to the group they belonged in, to share the score and its annotations.

Students could add general comments, such as the form of the piece, key signature, style, etc. They could highlight particular areas of the score and attach tags / names to them, such as motif 1, section B, perfect cadence in B, etc. They could highlight particular notes or parts of the score

Students were not given any training beforehand on the annotate software. The software was designed to be intuitive and simple to use. The students were told to email the instructor if they had any problems.

They were given two weeks to discuss their piece; at the end of the experiment, they were asked for their written feedback and suggestions. We analysed the quality of their analyses and the nature of their discussions.

5. Results

All students managed to use the system easily and add annotations to the score without any assistance. They added notes to different parts of the score, discovered how to give replies, and at points they even had longer discussions. Figures 1 and 2 show two screen shots of the process, with student annotations in their native language (Greek).

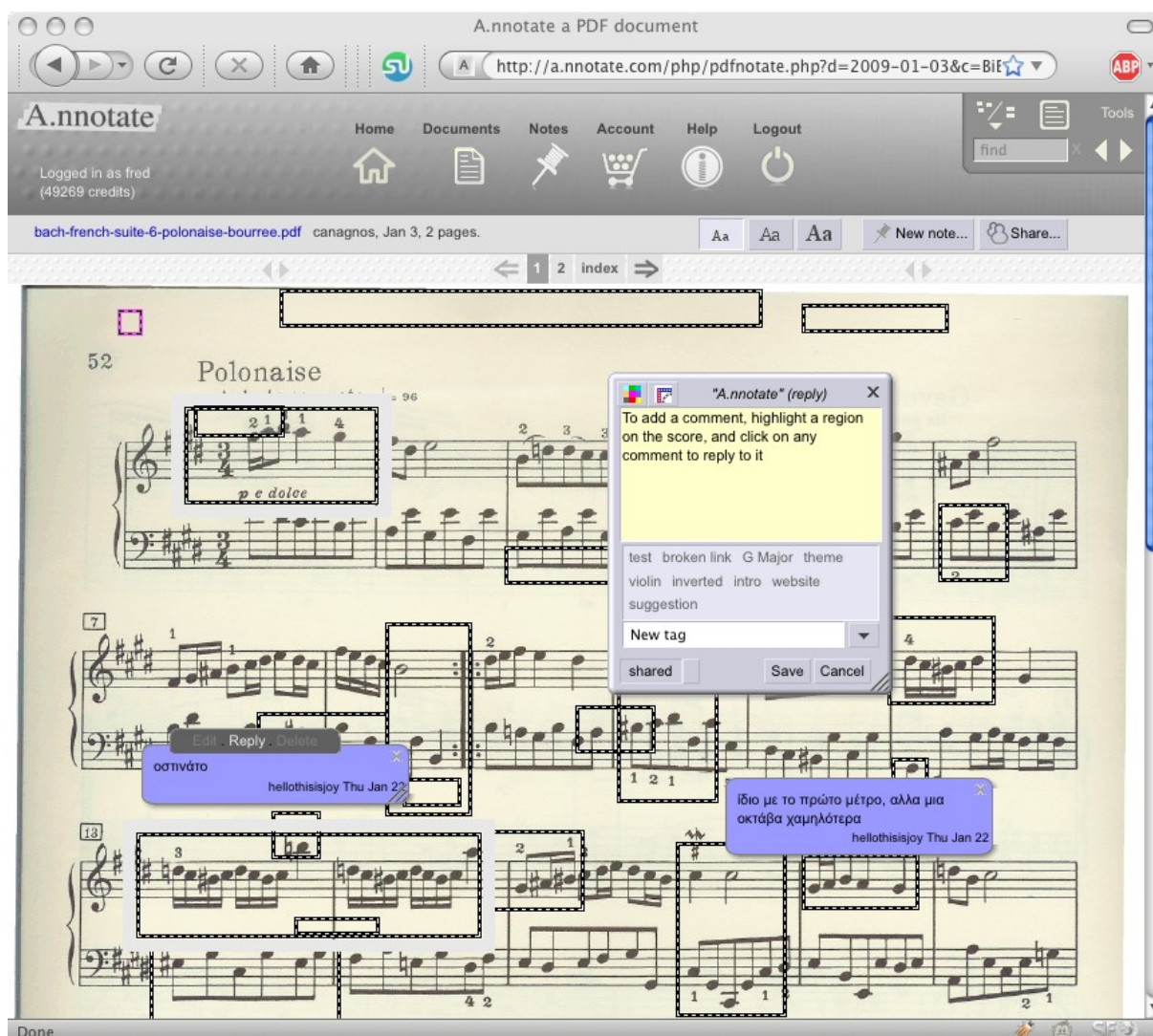


Figure 1: To attach a comment to a particular phrase, students highlight a rectangle and write a note in the box. The lecturer and other group members can click on any note to add replies.

The types of annotations varied. Students used different annotation boxes to denote different meanings. Annotations included information on the analysis of the piece, replies and discussions to other peoples' comments, links to the outside (youtube, listening to the piece), as well as more "chatty" information such as apologies for replying late, style of writing, arranging to meet up in class, and so on. Information on the pieces under analysis was often particularly high-level, and the best analyses occurred at points of discussion, where different opinions were voiced and different arguments presented.

The analyses produced were of a high level on aspects of morphology and harmonic analysis, which are topics that they had been already taught at length. Less was discussed on motif repetitions, variations and transformations.

Student feedback

An equally important part of the results was student feedback, which was achieved in the form of a questionnaire, in writing. However, several students emailed us afterwards too, giving us long thoughts and comments on their experience – something which shows us that the questionnaire was not an adequate form of feedback.

Among the questions asked on the feedback form were whether the students enjoyed the experience, whether they felt they learned something, and if so what, what they think of eLearning, using computers for teaching purposes, discussing with fellow students, and others.

Students' feedback about using A.nnotate for discussing music scores was given in writing by answering to a questionnaire, and was overall extremely positive. In general, it was thought to be an enjoyable experience, which motivated the students to work on music analysis. However, they stressed that this process cannot and should not substitute the real-time class experience, but rather used as a complement, or used in cases where there is no chance for meeting in a class. They felt they learned from collaborating with others, reading their annotations and discussing with them. They felt the software was easy and self-explanatory to use, and that they would use it in other contexts, such as annotating research papers.

They all enjoyed participating in the experiment, using the software and discussing with other students. They found they learned a lot from other students, and from discussions, although other students might not always be right. Not all students had a broadband connection at home though, so some had to use university computer labs to participate.

The screenshot displays the A.nnotate web application interface. At the top, the browser address bar shows the URL: <http://a.nnotate.com/php/pdfnote.php?d=2009-01-03&c=BiE>. The page title is "A.nnotate a PDF document". The navigation bar includes links for Home, Documents, Notes, Account, Help, and Logout. The user is logged in as "fred" with 49269 credits. The document being viewed is "bach-french-suite-6-polonaise-bourree.pdf" by "canagnos", dated "Jan 3", and it has "2 pages". The interface shows a list of annotations on the left and a preview of the music score on the right. The annotations are sorted by date and include details like the page number, the text of the note, the user's name, and the date. The music score preview shows the first page of the document, with various musical notations and annotations overlaid.

Annotations list:

- [page 1] το μέτρο αυτό πιστεύω πως είναι μια μορφή θέματος, η αρχική ιδέα του συνθέτη, η οποία επαναλαμβάνεται παραλλαγμένη και στην αρχή του Bourree. δεν ειμαι σίγουρη όμως αν πρέπει να το ονομάσω θέμα ή μοτίβο ή κεντρική ιδέα...
2 replies
hellothisisjoy Thu Jan 22
- εγώ προτείνω να κοιτάξεις 1ο-2ο μέτρο και όλη τη polonaise.
georgiamavrea Fri Jan 23
- δηλαδή?
hellothisisjoy Tue Jan 27
- [page 1] η ψηλότερη νότα
georgiamavrea Fri Jan 23
- [page 1] εμένα μου φάνηκε σαν να: η γραμμή του μπάσσο: μετά από αυτό το σολ, κάνει μια "παράκαμψη" (λα σολ# φα# μι# φα# μι ρε# μι φα# σολ#) και ξαναγυρνάει το ίδιο σολ για να συνεχίσει παρακάτω
georgiamavrea Fri Jan 23
- [page 1] τεχνητή δεσπόζουσα, V/ IV, IV
1 reply
hellothisisjoy Thu Jan 22
→ ok, αν θέλουμε να βάλουμε συγχорδια τότε μπορούμε
georgiamavrea Fri Jan 23
- [page 1] πτώση με V, δηλαδή μισή πτώση
1 reply
hellothisisjoy Thu Jan 22
στο μι# προσμένουμε αλλά τον πτώση τον βλέπουμε 1
georgiamavrea Fri Jan 23

Figure 2: All notes are added to an index page, making it quick to return to the right page later. Students can choose to be notified by email when someone adds a new note or replies to one of their comments.

6. Discussion and conclusion

The results from the above experiment were particularly promising. Students used the system successfully and produced high-level comments on the score. More importantly, they discussed various points with each other, which added to their learning experience.

The student feedback, as well as the subsequent comments of the students were an important part of the experiment and very useful to us. The students enjoyed the learning experience, were enthusiastic and motivated, and said they would value the use of the system to a larger extent in more University classes. That prompts us to expand its use as a more substantial part of the curriculum, by exploring further opportunities for using such tools in other areas of music education, such as music psychology and informatics, to annotate papers and share and mark homework assignments. However, we realise that the use of eLearning tools might be problematic with some cases of students who do not feel very comfortable in using computers. Also, students without a broadband connection at home can be disadvantaged.

Suggestions for new features included a “music” version of annotate, where staves can be added to annotations in order to be able to write music notes too, and the possibility for annotations to be linked to other annotations at different parts of the score. Finally, students would like to see a possibility to connect a single comment to several parts of the score.

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- [28] <http://www.adobe.com/products/acrobat> *- Adobe's suite of PDF products, which support annotation*