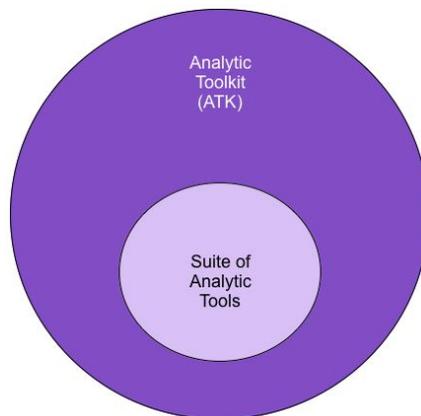


## Understanding and Using Knowledge Forum's Analytic Tools

Knowledge Forum has an evolving built-in Suite of Analytic Tools. These tools allow teachers and students to analyze their work in ways that have not been possible before. The purpose of this manual is to help knowledge builders understand how to get access to, start up, and use the current analytic tools suite.

### Introduction

Everything that students and teachers do online in Knowledge Forum can be tracked, saved, and used to create a picture, sometimes called a *structural signature* (Welser, Gleave, Fisher, & Smith, 2007), of the class and individuals in it. The current suite of analytic tools makes use of a subset of the data collected; the Analytic Toolkit (ATK) contains a larger set of data and is used mainly by researchers. Some of the ATK data may evolve into new assessment forms and become part of the Suite of Analytic Tools. Figure 1 shows this relationship.



**Figure 1.** Diagram showing the relationship between the Analytic Toolkit (ATK,) and the Analytic Tools Suite.

This manual will discuss the Suite of Analytic Tools that currently appears in Knowledge Forum.

### General Comments about Online Assessment

As already noted, online assessment of the kind being discussed here is quite new. These show new kinds of information to the teacher, and in great detail. However they are not intended to stand alone as independent measures. Instead, in order to



correctly interpret the analytic tools results, the teacher needs their own special knowledge of their class and students. As well, no one tool should be used alone and relied upon solely. It is best to consider the tools in combination to get a fully rounded picture of the class and individual students.

A second factor for consideration is that these tools allow the teacher to see both individual and group processes. In the past, most academic assessments have focused on the individual. Being able to examine group processes in detail is new, but essential in light of the movement towards teaching and assessing 21<sup>st</sup> century skills (Johnson, 2009).

Finally, it is a truism that what is valued is what is assessed. Schümer et al. (2005) note that if interaction and collaboration are not assessed, they will not take place as much as desired. It is therefore essential that the students know what is being assessed and how. Where possible, the students should be encouraged to use the analytic tools to assess their own performance.

### Starting the Suite of Analytic Tools

Figure 2 shows the icon for the Suite of Analytic Tools. It is designed to look like a column graph, and located on the toolbar to the left of the view window. The icon is a button, and clicking on it brings up the Suite of Analytic Tools.



Figure 2. The icon for the start-up of the Suite of Analytic Tools.

Figure 3 shows the window for the Suite of Analytic Tools. This allows teachers and students to select which of the tools they wish to use. Clicking on any of the buttons on the left will start the program for the tool requested.



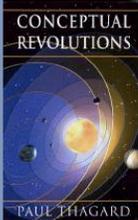
	<a href="#">Contribution</a> <i>by Paul Johnson</i>
	<a href="#">JavaECHO</a> JavaECHO is an implementation of ECHO, a system for computing explanatory coherence developed by <a href="#">Paul Thagard</a> and explained in detail in his 1992 book Conceptual Revolutions. <i>by Toby Donaldson</i>
	<a href="#">SemanticOverlap</a> <i>by Chris Teplovs</i>
	<a href="#">SocialNetwork</a> <i>by Paul Johnson</i>
	<a href="#">VocabularyGrowth</a> <i>by Jud Burtis</i>
	<a href="#">Writing</a> <i>by Ben Smith Lea</i>

Figure 3. The Analytic Tools window.

The window for the Suite of Analytic Tools may change as new tools are added. The Analytic Tools are new and evolving. However a number of the tools have already proven useful to teachers and we will focus on them in this manual. These are the Writing tool, the Vocabulary tool, the Contributions tool, and the Social Network tool.

One note: As each analytic tool starts up, a window entitled “Applet” appears. Applets are programs written in the Java programming language and work through a web browser window. If you do not have Java installed on your machine, you may have problems getting access to the analytic tools suite. Likewise, the firewalls used by some organizations can be problematic. If the analytic tools do not work for you, it is probably due to one of these causes.



## The Writing Measures Tool

On clicking on the button for the writing measures tool, the writing measures window appears (Figure 4.)

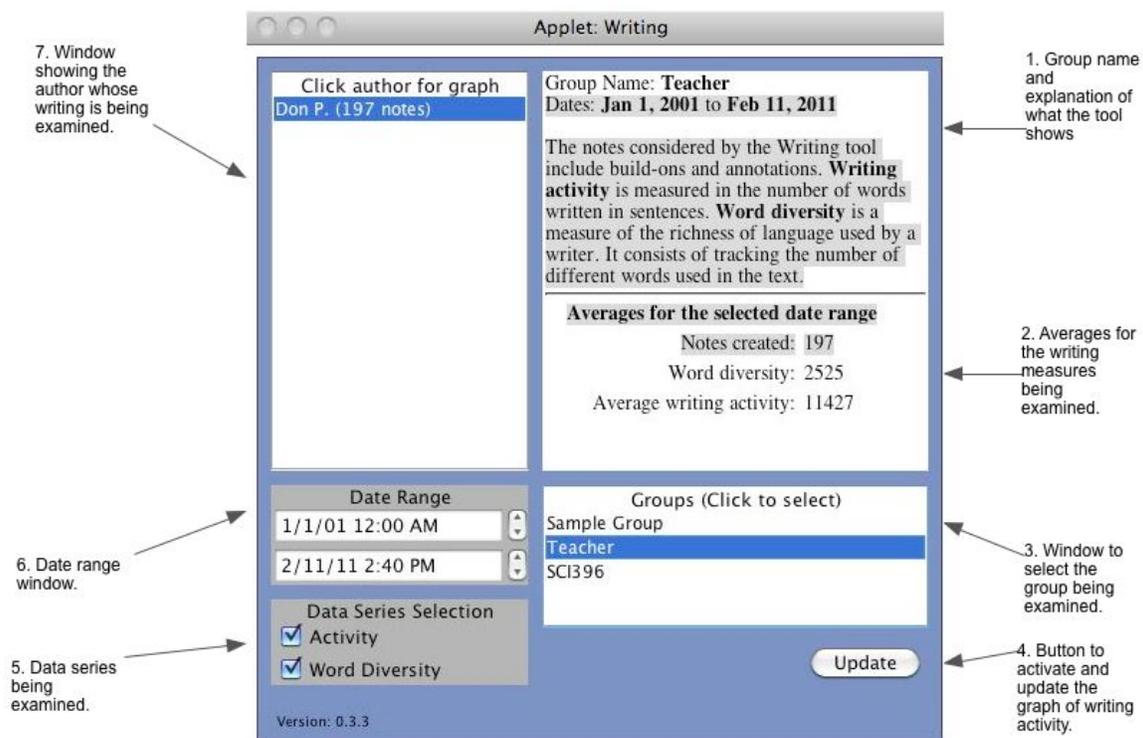


Figure 4. Writing measures window showing the various parts and what they do<sup>1</sup>.

As is common in many computer applications, the writing measures window is a container that holds a number of other windows. Looking at Figure 4, and starting at the upper right and moving clockwise, we first see that window 1 displays the name of the group being examined, in this case *Teacher*. Knowledge Forum allows the teacher to specify a number of different groups within a class. This

<sup>1</sup> I think there's a problem with window 2, the averages window. The number of notes created does not appear to be an average, nor is the writing activity an average.



is set up when the teacher first starts Knowledge Forum for their class. In this case, the teacher is in a separate group from the students, but that is a teacher's decision—others may wish to do it differently.

Window 1 also shows the dates selected, and describes the writing tool. *Writing activity* includes all notes, as well as build-ons (responses,) and annotations to notes. *Word diversity* looks at the variety (richness) of different words used by the student (or in this case, teacher,) being examined.

Moving clockwise (down) to window 2, we see that it displays the number of notes created, and averages for word diversity, and writing activity. “Teacher” created 197 notes during the date period being examined, averaged 2,525 different words used, and 11,427 of the text units were in sentences. Results for a student would be different, but for reasons of confidentiality, I cannot show these here. What a teacher should look for in the writing measures is extreme highs and lows.

Taking low scores as an example, a student who created few notes, had low word diversity, and few sentences might have some kind of reading or writing problems that needs to be addressed. This will vary by age, grade, and other factors, so the teacher should use their own best judgment as to what “low” means for their classes. Likewise, a student with a high score for notes created, but low word diversity and writing activity might be a student who is not fully engaged in the work of the class and is contributing notes to look active. Again, the teacher would be the best judge of this.

Moving clockwise (down) to window 3, we see that it allows us to select the group being examined. In this case, the group “Teacher” is being examined, and has only one member, Don P. After choosing a group, the names of the group members are displayed in a window on the upper left (window 7.)

Finally, on this side of the Writing Activity window, we see window 4, the “Update” button. After all parameters have been selected, clicking on the Update button creates a graph (discussed below) that shows the word diversity and writing activity over time.

Moving clockwise to the lower left of Figure 4, we see the Data Series Selection Window (5.) This has two check boxes that allow the teacher to see what data should be displayed on the graph. In this case, both Activity and Word diversity are checked (the default setting.) The teacher can change this depending on what they want to display.



Window 6 is the Date Range window. This allows the teacher to examine data for the selected date. The default value is from the date the Knowledge Forum database is first created to the present. However, this can be changed so that the teacher can examine specific dates (perhaps from the beginning to end of a unit of study or other meaningful time periods.)

Finally, window 7 shows the names of the individuals in the group chosen. In this case, the Teacher group had only one individual, Don P. Other groups will have more individuals, and clicking on the name will allow the teacher to examine their graph.

### The Writing Tool Graph

Figure 5 shows the writing tool graph.

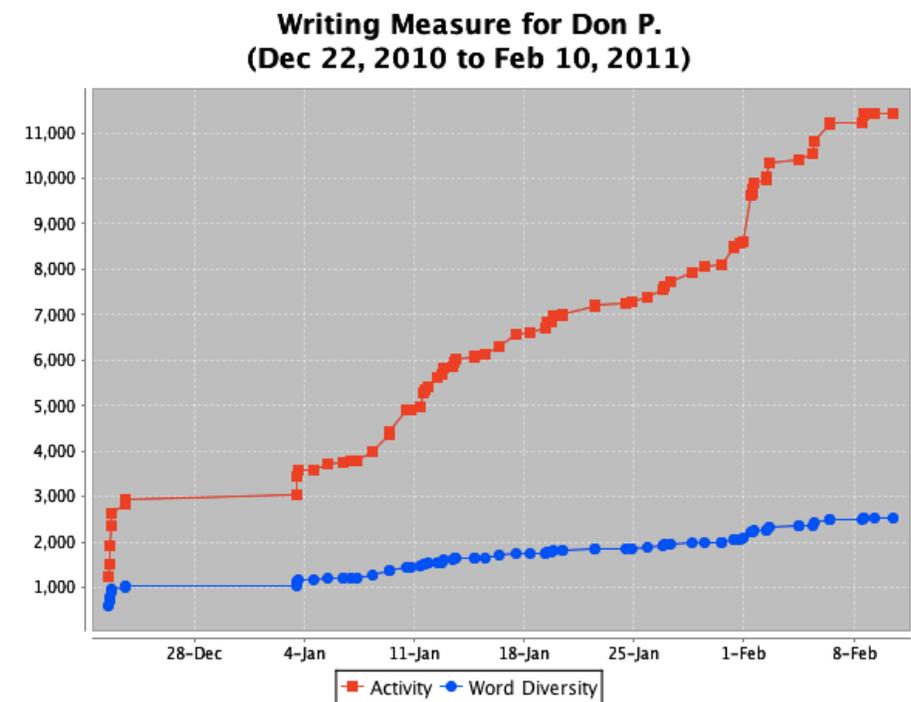


Figure 5. Writing measures graph.

In Figure 5, the writing activity is shown in red and the word diversity is shown in blue. The date range is from the date of creation of the Knowledge Forum database to the time of writing of this manual entry. As can be seen there is early



activity as the teacher set up the database, then a period of stasis before the class actually began. On January 3, we can see the beginning of class, and a steady increase in both activity and word diversity as the class continues. At the beginning of February, we see a jump in writing activity.

This graph shows steady, regular work on the part of the teacher—which is to be expected. What we don't want to see among the students is the kind of line we see between early December and January 3. This shows no activity, in this case because the class hadn't started yet. However if the class had started, and the graph was that of a student, it would indicate that the student was doing little or no work in Knowledge Forum at all. We would wish to see a steady rise in writing activity and word diversity, although it need not be as steep as we see here for writing activity.

### Summary of the Writing Activity Tool

The writing activity tool consists of two parts: the Writing applet window that allows the teacher to control what information is displayed, and the Writing Measures graph that displays the information the teacher has chosen.

The Writing Measures graph can show one or two lines, and the default choice is both together. What a teacher should look for is steady work, not a flat line that indicates little or no work being done.

As always, interpreting the data needs the teacher's special knowledge of their class. Holidays will cause flat lines of activity, as will absences due to illness, computer breakdowns, and other problems.



## The Contributions Tool

Posting a note in Knowledge Forum, building-onto a note by another student, making an annotation and so forth are viewed in knowledge building pedagogy as making a *contribution* to the work of the knowledge building community. The contributions tool is therefore designed to graphically display the various kinds of contributions made by the students so that we can better understand who is, and who is not, contributing to the growth of knowledge in the community. The result is displayed as a column graph sorted from lowest number of contributions to highest. This section will explain the control window for the contributions tool, and how to interpret the graph(s) produced.

### The Contributions Applet Control Window

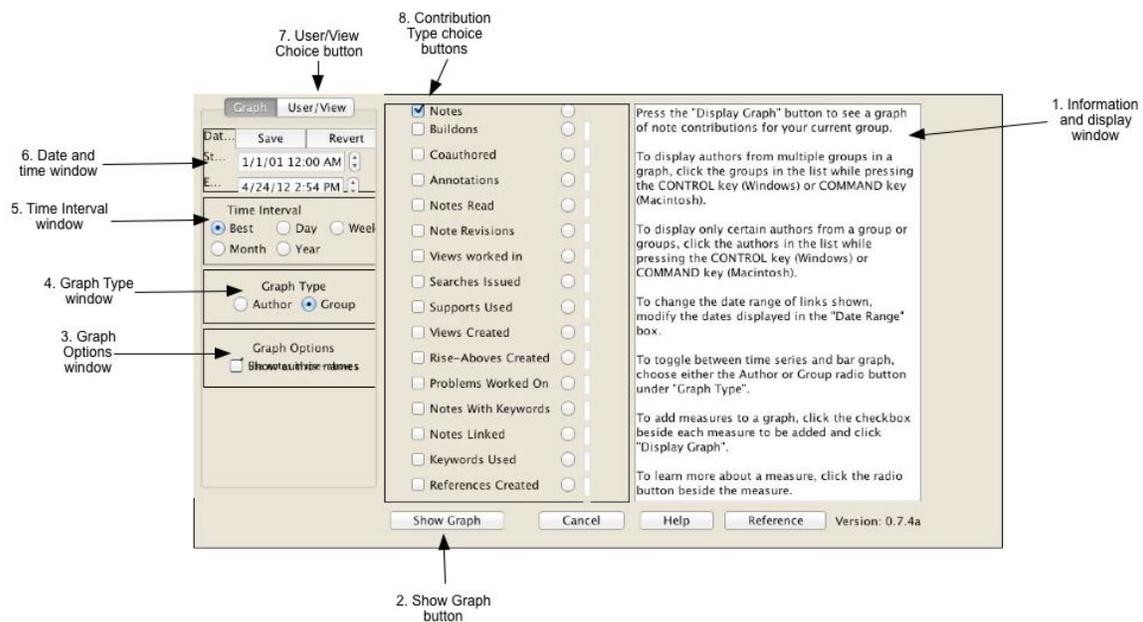


Figure 6. The Contributions Applet control window.



Starting on the right of Figure 6 and moving clockwise, number 1 is the information and display window. When the applet is first started, the window displays information about how to use the applet. However once the Show Graph button is clicked, the display changes and the names of the students in the selected group scroll past. This helps the teacher to see that it is the correct group being analyzed.

Moving clockwise to number 2, we see the “Show Graph” button. When this is clicked it does two things: it loads and analyzes the desired data (in this case note postings—see number 8), and when this is done, it opens a new window and displays a graph of the data.

Number 3, the Graph Options window is not active in the present version.

Number 4 is the Graph Type window. It allows the teacher to select whether they want to see an individual author’s work, or that of the entire group. The Group radio button is selected as the default.

The Time Interval window (number 5) allows the teacher to select the time period they wish to examine. The Best radio button is pre-selected as the default here.

Number 6 is the Date and time window, and allows the teacher to have a finer grain of control over the time period displayed than the Time Interval window does.

Number 7 is the User/View Choice button. Clicking on this brings up a new window that allows the teacher to select the users and groups to display. The default is the Sample Group, and usually the teacher would want to change this to their class, unless they have left their class as the Sample Group default. If the teacher wants to display individuals from multiple groups, they should click on the groups while holding down the CONTROL key (Windows computers) or the COMMAND key (Macintosh computers.) As well, the teacher can choose to display data from all views, or from a selected view. Clicking on the desired view allows for a single view to be displayed; the default is to display data from all views.

Number 8 is the Contribution Type choice radio button window. The teacher can select to display graphs of note postings, build-ons, annotations, etc.—any form of contribution that Knowledge Forum allows. Each will appear in a separate graph window, so the teacher can display a number of different graphs for comparison. *Caveat:* On some computers these graph windows will appear on top of one another,



making it look like the first graph has been replaced. Dragging the new graph window will reveal the original graph.

### The Contributions Graph Window

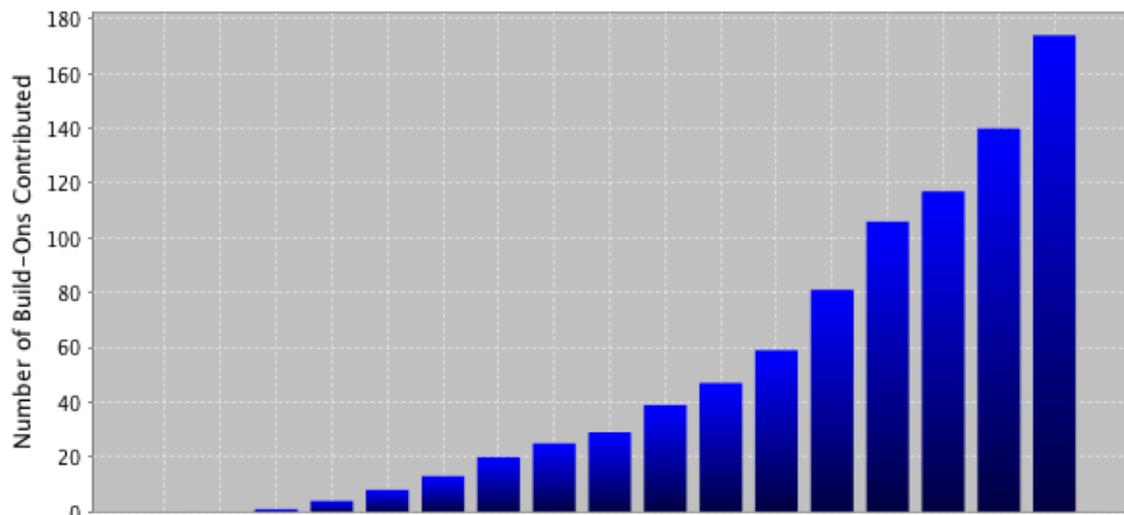


Figure 7. A contributions graph window, in this case showing build-on contributions.

Clicking on Show Graph starts the analysis and Figure 7 shows a typical Contributions graph that results from it. Here, we have removed the identifying information as to the class, and the names of the students. Normally these would appear, along with the total number of contributions. Figure 7 shows the number of build-on contributions as a column graph, sorted from lowest on the left to highest on the right.

As can be seen on the left, some students have made very few build-on contributions, while others (on the right) have made many. Ideally in a knowledge building class, we would wish to see evenness of participation in building-on, so the students who are not contributing very much are a cause for concern. However there can be multiple reasons for this, such as a student being absent for a period of time, a student working remotely and having a slow connection, and so forth. These data by themselves cannot tell the teacher what the problem is, but can alert them that there may be a problem that they should look at.



All of the Contributions graphs are similar: all are column graphs, all are blue, and all are sorted lowest to highest. Although we have removed identifying information here for reasons of confidentiality, that information is normally displayed so that the teacher knows what type of contributions they are looking at, and who made them.



## The Vocabulary Growth Tool

Vocabulary growth can be analyzed by examining the words used as students post notes and build-ons. This section will demonstrate the Vocabulary Growth window and how it is used to analyze students' vocabulary growth.

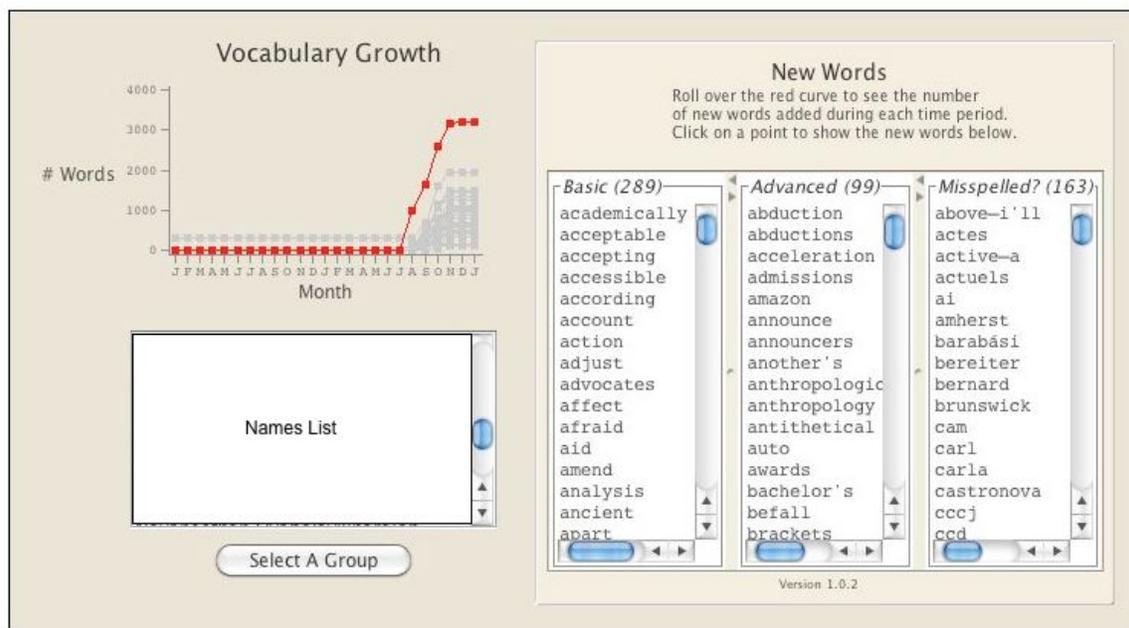


Figure 8. The Writing Measures control window. Actual group names have been blanked out and the word "names list" inserted. In reality, this would be a list of group names.

In the Vocabulary Growth tool window, we can see four areas: Vocabulary Growth, a list of names (blocked out here), the "Select A Group" button, and the New Words window.

In order to start using the Vocabulary Growth tool, we first need to select a group to analyze. Clicking on the Select A Group button does this, and a list of groups associated with a particular Knowledge Forum database will appear. Once the group has been selected, a list of names appears in the names list window. Selecting a name allows the teacher to see the vocabulary growth for an individual student. This appears in two forms.



Selecting a student name will cause a graph of that student's vocabulary growth to appear. Clicking on any of the nodes on the graph will activate the New Words window. The New Words window has three areas: "Basic" words area that shows the words from the Oxford corpus of 3,000 basic English words that the student has used; an "Advanced" words area that shows English words that are not part of the basic corpus; and finally a "Misspelled?" words area that shows words that may be misspelled, foreign, or names that are not found in an English dictionary.

Typically the growth of vocabulary shows as a sigmoidal curve (a flattened "S" shape): a slow, flat start, then rapid growth as new words are added, and finally a flattening of the curve as there are fewer new words on the topic being studied to be learned.

The growth of the vocabulary of the individual student can be compared to the vocabulary growth of the other class members (greyed out, but visible on the graph.) In this way the tool allows the teacher to see both individual and group patterns.

Interpreting the graph in this case is quite simple. If the curve is relatively flat, the student is not using many words at all. They may not be contributing notes or build-ons, or there may be other reasons. A low vocabulary growth would alert the teacher of a possible problem. As well, the teacher can examine the advanced words to see if the student is using domain-specific words. An absence of these would also alert the teacher to possible problems.



## The Social Network Tool

One of the key elements in establishing a culture of knowledge building in the classroom is the formation of a functioning knowledge building community. However it can be difficult for a teacher to determine if this is happening. One way to do this is to examine the social networks that form during Knowledge Forum use. Simply put, a community can be defined by the connections that form among the members, and social network analysis can demonstrate these.

Among the 21<sup>st</sup> C skills most often mentioned are collaboration and teamwork (Partnership for 21st Century Skills, 2008). These are group processes rather than individual processes and until recently, we haven't really had the tools to assess collaboration and teamwork. Social network analysis of online interactions gives us that ability, allowing for us to make formerly invisible processes visible (Cross, Borgatti, & Parker, 2003). To understand the social network tool, we need first to look a little bit at what social network analysis is, how data are displayed, and what they mean.

### Social Network Analysis

Social network analysis is a form of analysis that examines the relationships among the individuals in the social network (Marin & Wellman, 2009). In the wider world, these can include family relationship networks, friendship networks, business networks and so forth. We all participate in a number of social networks, and these can be analyzed separately or together. In Knowledge Forum, we examine the networks that form as the students interact online, and data are collected automatically. These networks include the note reading network, the building-on network, the annotations network, and so forth.

Among the principal tools of social network analysis is the *sociogram*. This is a graphical representation of the network under study, a kind of map showing the position and relationships for the various actors in the social group. Figure 9 shows a sociogram.





student 18 built-onto a note by student 19. Arrow directionality is important, as one-way interactions (as between 18 and 19) are good for passing on simple information, but complex knowledge needs reciprocal and frequent interactions. Looking at students 6 and 8, we can see that the connecting line is dark, indicating frequent interactions, and that the arrowheads are bi-directional, indicating reciprocal interactions. This indicates the potential for complex information transfer between these two students.

Sociograms can be presented in a number of ways. The simplest and most traditional is a circle with all nodes spaced equally about the perimeter and connecting links drawn between. However *spring* or *force-based* algorithms provide more information about social roles. Knowledge Forum can display data in either traditional circular or spring algorithm forms.

*Spring* or *force-based* algorithms assign attractive or repulsive forces to the actors in the network based on the frequency and nature of their interactions. The nodes are then allowed to interact in the computer and distributed according to the results of these interactions. Those with the most frequent and reciprocal interactions move to a more central position, and those with less frequent and non-reciprocal interactions move to a more peripheral position.

The current social network tool in Knowledge Forum uses *indegree centrality* for its spring display. Indegree centrality uses the frequency with which someone reads, annotates, or builds-onto notes by a given student. Indegree centrality is calculated separately for each student. The force-based algorithm then uses this to calculate their relative positions. Indegree centrality is used because it is a common and well-understood measure, and because social network analysts use it as a measure of *power* (influence) within a community (Wasserman & Faust, 1994).

One sociological definition of community is a connected sociogram. If all members of a defined group are connected to the sociogram, then the group is considered to have formed a community. In the figure above, we can see that there are no non-participants, no unconnected nodes. Therefore the sociogram is completely connected and we can infer that a community has formed. This does not, by itself, demonstrate knowledge building, but does indicate that the students are engaging in the kinds of behaviours consistent with the formation of a knowledge building community.



To better understand this, we will look at an example using the Knowledge Forum social network tools.

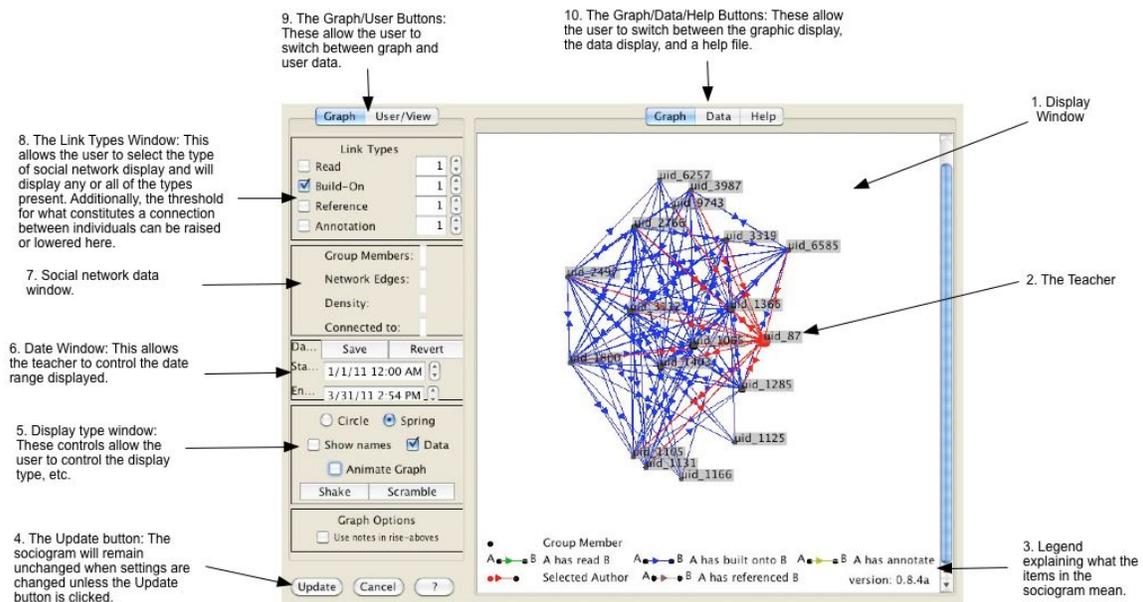


Figure 10. The social network analysis tool showing the building-on network for a class.

Starting at the upper right-hand corner of Figure 10, we can see the Display window at number 1. This is the window that displays the sociogram, in this case, a spring (force-based) sociogram. When the sociogram starts up, the data for the individual who is logged on, in this case, the teacher, is displayed in red (number 2). Clicking on any white space will turn this off on the sociogram. Number 3 shows the legend that tells the user what the colours of the lines mean (in this case, blue for build-ons).

Moving clockwise to the lower left, we see at number 4 the Update and Cancel buttons. *Every time a user makes a change in any of the parameters being examined, the Update button needs to be clicked to instantiate the changes.*

Moving upwards from number 4 to number 5, we see the window to control the display type. The sociogram can be either a traditional circular display, or a spring (force-based display.) Both have merits, and the teacher should experiment with them to see when they work best for their class.



Remaining at number 5, we can also see that the display can show names or data. For reasons of confidentiality, it is sometimes necessary to display the data without actual student names, as is the case in the sociogram above.

Finally, the last item in number 5 is the Animate Graph button. When calculating the positions of the nodes, the computer actually works in an  $n$ -dimensional space. It will continue calculating the positions of the nodes relative to one another. Initially the display will be a circle, and as the calculations proceed, the nodes will move into a final position, but will “jiggle” a little as the computer updates the positions from different perspectives. To stop this, the Animate Graph button should be clicked off when the nodes reach their final positions (as has been done here.) Experimenting with this a little will aid the user in understanding how this works.

Spring (force-based) representations are useful in determining visually which individuals are central and which are peripheral to the group. However there is one *caveat*: in groups that are very regular (even) in participation, there may actually be no central individuals. Instead some individuals may *appear* to be central, but this is an artefact of a 2-D representation of an  $n$ -dimensional system. Clicking on the Update button without changing the parameters can demonstrate this effect. If the individuals who were previously central no longer are in the updated version, then participation is very regular and there really isn't a central group. However if the nodes move about, but the same group remains central, then there is a true core/periphery structure to the group. Another way to tell this is by the regularity of the structure of the sociogram. Highly symmetrical-looking sociograms tend to lack a core-periphery structure; asymmetrical sociograms tend to have a core-periphery structure. A little experience will demonstrate this to the user.

Number 6 shows the controls that allow the teacher to control the dates for which data are displayed. The default here it from when the Knowledge Forum database was created to the current date. However that teacher may wish to look at a particular week or month, and changing the parameters allow for this.

In the current version, number 7 is disabled.

Number 8 allows the teacher to choose the type of link they wish to have displayed. These link types will display the note reading network (the network showing who has read whose notes,) the build-on network (showing who has



responded to whose notes,) the referencing network (showing who has referenced whose notes,) and the annotations network (showing who has created an annotation to whose notes.) These networks are usually displayed separately, but can be displayed together by clicking on all of the checkboxes. However, this may create a difficult to read sociogram.

To the right of each checkbox for choosing the link type is a box that allows the teacher to set a threshold for the minimum number of interactions for a link to be displayed. As time goes on in the class, the sociogram for any link type could become quite dense and difficult to read. Raising the interaction threshold will make the sociogram easier to read, and give better information as to the actual core groups, etc. Again, this is a case where experimenting with changing the link threshold will clarify for the teacher what this means. Please remember that the Update button has to be clicked for any change in the parameters to be displayed.

Number 9 contains two buttons. The default shows the display window and the various functions we have discussed here. Clicking on the User/View window allows the teacher to specify which groups and particular view is displayed. The default is the Sample Group, and this is often empty (depending on the teacher.) Should the display not show the class data, this is probably the problem and the teacher needs to select the group to display. As well, the system defaults to showing all views. If a particular view is desired, the teacher needs to select it.

### What the social network tool means in practice

The social network tool is useful for showing the relations among group members. As well as knowledge building, this relates to 21<sup>st</sup> century skills such as teamwork and leadership, communication skills and so forth. Persons who are central to the group are more influential than persons on the periphery. What should the teacher be looking for in the social networks?

The reading and building-on networks are the most important to look at. All students should be connected to these networks. A student who is disconnected is not participating in that network. Likewise a student who is on the extreme periphery is not participating as fully as they should be. So the first things a teacher should look at in the social network tool are the people who are on the outer edges



of the Spring view of the social networks. Let's look at an example from Figure 10 to see what this means in practice (21<sup>st</sup> C skills are indicated by italics.)

Most important, we can see that the sociogram is completely connected, with no non-participants. We can infer from this that a building-on community has formed. Again, this does not prove knowledge building, but is indicative of it.

Looking at Figure 10, at the bottom, we can see uid\_1125. The size of the node is small, and indicates that few students have read any note postings by this student. A larger node indicates a larger number of indegree connections. As well, there are only four links to this student, and their node is located some distance from the centre of the group. These data indicate that the student has contributed few build-ons and that few or no students have built-onto them. Unless the student has been absent or ill, he or she is not participating well in the build-on network, and this is something that the teacher might wish to address.

Another student, uid\_1366 is located just above and to the left of the teacher (red node.) Their node size is large, and they have a good number of reciprocal connections. This student has both created build-ons and had other students build-onto their notes. They are participating well in the build-on network. This student could be regarded as taking a *leadership* role in the network.

As noted above, we can see that it is a highly connected network, with no students isolated from the network. However it is *asymmetric*, an indicator that participation is not even among the students. The variation in node size also indicates this. In terms of *teamwork* we can say that while the class is cohesive for building-on, some members are carrying more of the load than others. In addition, we can see *interpersonal* and *collaborative* skills in this network: Students with few links are not showing good collaborative skills, and students with more links are showing better collaborative skills for responding to others. A key knowledge building principle is Community Knowledge, Collective Responsibility (Scardamalia, 2002). This asks that the students should try to advance the work of the group as a whole. The 21 C. skill *social responsibility* asks that students act, "... with the interests of the larger community in mind ..." (Crane et al., 2005)—almost identical to the knowledge building principle. In Figure 10 we can see that not all students are being equally socially responsible for building-on: some are contributing much more than others, and some are doing very little at all.



## Types of Networks

Boutillier (2009) has provided a useful classification system for networks. In this section, we will look at examples of three of these network types and discuss their implications for knowledge building.

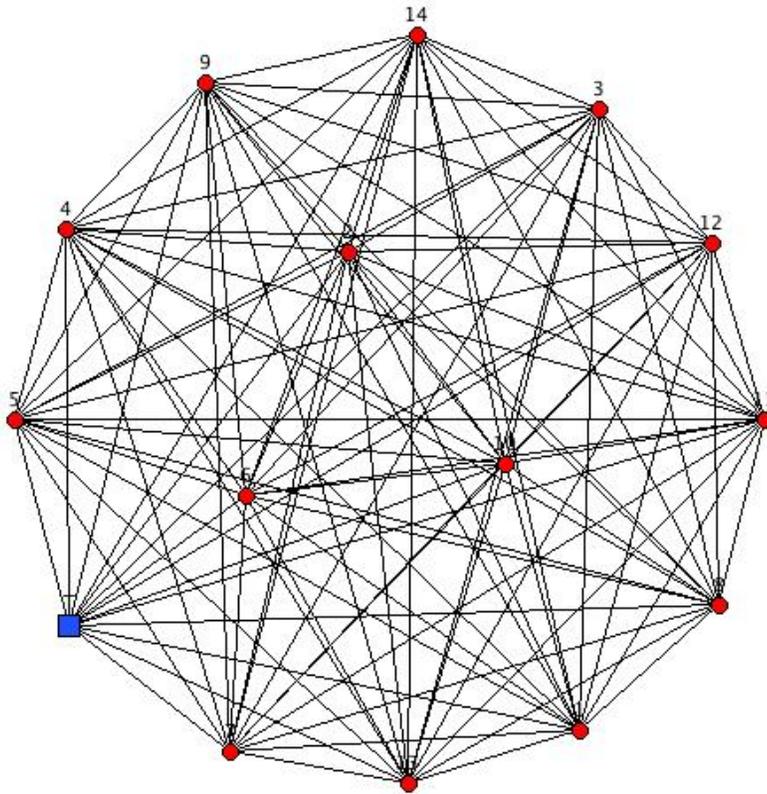


Figure 11. Sociogram showing an example of Boutillier's perfect equality network.

Figure 11 is an example of Boutillier's *Perfect Equality* network. All students and the teacher (blue square) have exactly the same number of interactions, and the teacher is not central to the network. The network is also highly symmetric, giving the



impression that three students are central, but this is the artefact mentioned above: it's a 2-D projection of a 3-D system, and these students are actually no more central than anyone else. When the network is highly symmetric, this artefact will probably be seen.

For knowledge building purposes, this network represents an ideal that will most likely not be seen in practice. However some networks come very close to this. This is the type of thing most knowledge building teachers would be striving for.

Figure 12 is an example of Boutilier's *Silo Organization* network in which there are three groups who communicate among themselves and with the teacher (blue square), but not among the groups.

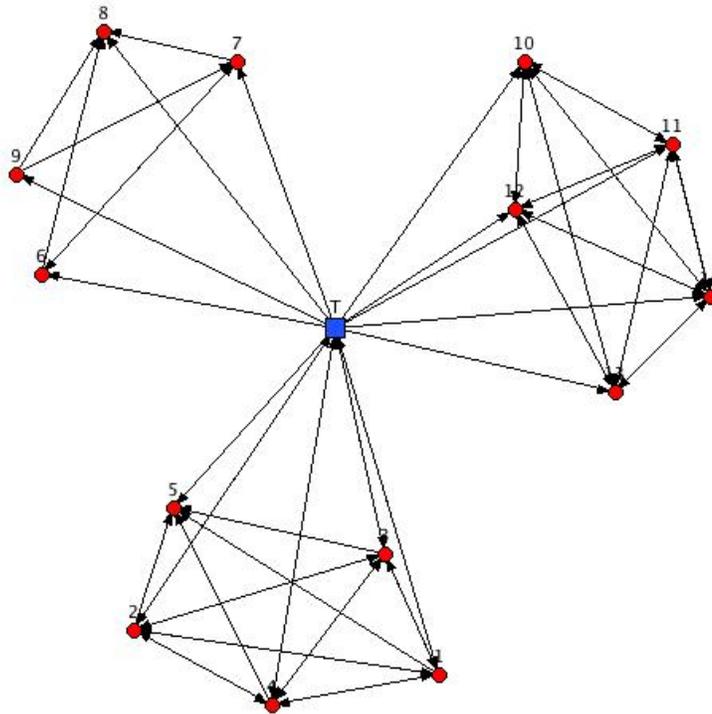


Figure 12. Sociogram showing an example of Boutilier's silo organization network.



The Silo Organization network type can be the result of planning, as seen in Zhang et al. (Zhang, Scardamalia, Reeve, & Messina, 2009) in which the teacher deliberately divided the class into groups to work on a problem. Some teachers also divide larger classes into groups in order to reduce information overload. A problem with this type of structure is that the teacher becomes central to the network, and indeed the only conduit through which information flows from one group to another. This can inhibit knowledge building. Therefore most knowledge building teachers prefer a greater degree of communication among the groups so that the silos are not as insulated from each other as in Figure 12.

If a Silo Organization network appears spontaneously, it may indicate ethnic, religious, gender or other homophilies among class members, and this should be discouraged.

Figure 13 shows Boutilier's *Perfect Dictatorship* network type. In it, the teacher is central to the network, and there is no communication among group members. This is similar to the structure found in some online courses that are run on the old distance education model: the teacher posts assignments online, the students do them in isolation, and return the completed assignments to the teacher. This Perfect Dictatorship network type is antithetical to knowledge building and should be avoided.

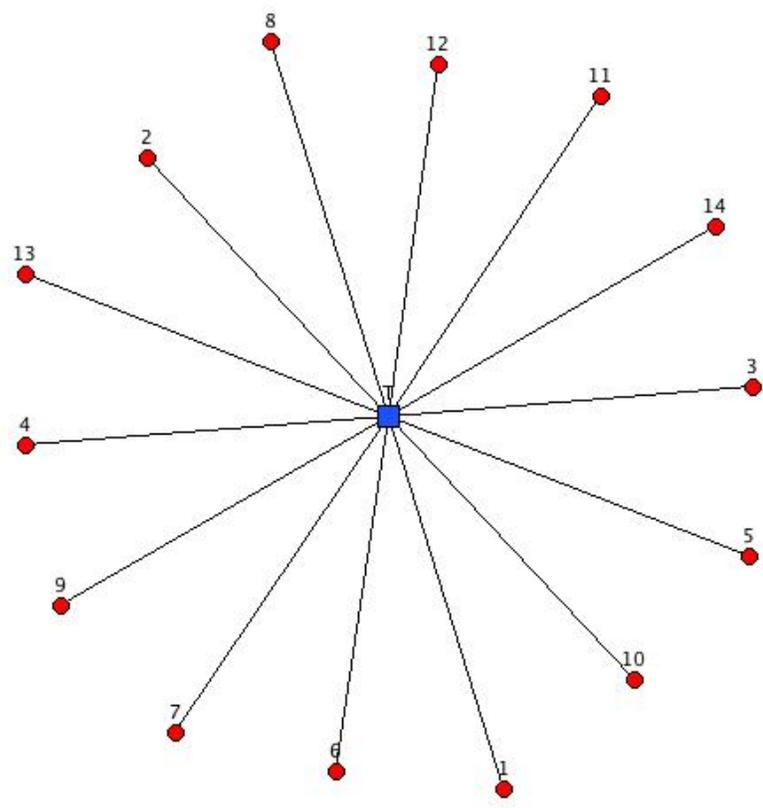


Figure 13. Sociogram showing an example of Boutillier's perfect dictatorship network.

The Perfect Dictatorship network type can occur spontaneously among groups of students who have previously been discouraged from working collaboratively (as can happen in highly competitive environments like undergraduate science classes.)

There is one *caveat* here however: Sometimes this network structure appears in views that are used solely for administrative purposes. For example, if one view is used for teachers to post readings and for students to download them,



this kind of structure can emerge. As long as this isn't found in discourse views, it isn't a problem.

Boutilier actually gives nine distinct network types, so there are intermediate types between these examples. The structure we most wish to avoid is a one in which there is a central core of high contributing students and the rest of the students participating in a desultory fashion on the periphery, or disconnected from the network.

As a final point about network structure, it should be noted that networks take some time to form, and often have a structure similar to the Perfect Dictatorship or Silo Organization as they form. Mature networks can take a week or longer of continuous work to form, and the discussion here has related to mature networks. Once the network has matured, it tends to keep the same structure until the inquiry is concluded. Teachers should not be too concerned if the early formation of the network looks "wrong." However if things do not change over time, then perhaps some intervention would be in order.

### Social Network Analysis Tool Summary

This section has been somewhat long because sociograms pack a lot of information into a small image, and because some interpretation is required. Here are the basic points.

The social network analysis tool displays information about communication patterns among the class in the form of a sociogram or network map. There are two main kinds of sociogram: the traditional circular sociogram and the Spring (or force-based) sociogram. Force-based sociograms can be a little messy to read sometimes, but give a lot of information about who is central and who is peripheral to the network.

The type of network matters. Some network types are more conducive to knowledge building than others. The Perfect Equality network represents an ideal. It is not uncommon to find one among note reading networks, but is more difficult to achieve among building-on (response) networks.



Sociograms can tell the teacher a lot about how knowledge building is progressing in the class, but should not be used in isolation. The teacher's own unique understanding of the class is critical to understanding the dynamics, as is data from the other tools. The sociograms can also be used to assess 21<sup>st</sup> C skills such as effective communication and social responsibility.



## Final Comments on the Use of the Analytic Tools

The analytic tools use data mining—analyzing the server log data that is produced as teachers and students interact online. This is a relatively new and somewhat experimental. Such data mining can produce a great deal of data and multiple analyses—so much that it can be overwhelming for the teacher. As well, different systems may use different measures. Here, we have chosen to use graphical displays because they are easier to interpret quickly than lists or tables of raw numbers. Neither have we included every measure we can. We have used only those in which teachers have expressed an interest and that we feel are meaningful in terms of showing how knowledge building is proceeding in the class.

As noted earlier, one thing about the analytic tools needs to be emphasized: these cannot be used without the special knowledge the teacher has about their class. Neither should they be used in isolation. Instead the teacher needs to look at a number of the tools together to get a true picture of their class. With a little practice, this is really quite easy.

We would be happy to receive suggestions as to new measures to use, or new forms of display that we might create.

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