

INVESTIGATING THE SOCIO-CONSTRUCTIVIST DIMENSION OF ONLINE INTERACTIONS: THE CASE OF SYNCHRONOUS AUDIO-GRAPHIC CONFERENCING SYSTEMS

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Abstract

This study explores the quality of interactive patterns in audio-graphic conferencing environments and learners' involvement in interaction. Supporters of this technology claim that online interactions support socio-constructivist language learning. However, the existing literature does not indicate whether the quality of interaction required for realizing constructivist principles of learning can effectively be ensured in such environments.

The study is based on the UK Open University's online audio-graphic tuition environment Lyceum. It investigates the verbal and written interactions of adult Open University students learning French. The data is analyzed by different models of analysis pertaining to different socio-constructivist and cognitive models of analysis.

The results show that students use high forms of thinking to engage in a cyclical rather than a linear process of knowledge construction. However, there is no evidence that this process is supported by the audio-graphic system itself. The tutor's style and task design play a more important role in supporting the learning process.

1. Introduction

Synchronous audio-graphic conferencing systems have become very important and an integral part of online language learning. They are known as online tuition. Audio-graphic systems utilize a computer for synchronous communication between the instructor and the learner. They typically have a voice component (speaker and microphone), chat (instant messaging), desktop sharing, and whiteboard capabilities. Some audio-graphic systems also make use of drawing tablets or similar desktop applications. This technology is used for synchronous instruction. In this context, social constructivism is one of the currently accepted language learning theories (Hampel & Hauck 2004).

2. Theoretical Background

2.1. Socio-constructivism

Socio-constructivism holds that learning is an ongoing process of knowledge construction. It emphasizes the importance of interaction and brings out how knowledge construction and appropriation are as much a function of the immediate context of social interaction as well as individual cognitive processes (Vygotsky 1978, Lantolf 2000). In this direction, Heylighen holds that 'knowledge is the product of many learner-centred processes as well as the social processes of collaborative communication and negotiation' (1997: 2). Vygotsky (1978) argues that learners work together to co-construct knowledge through agreement between the different cognitive patterns within an individual's brain, and consensus which is an agreement between the different cognitive patterns of different individuals. He proposes the zone of proximal development where learners collaborate through articulating ideas, sharing information, reconstructing their individual experiences, negotiating meaning through socially mediated interaction and hence co-construct new shared knowledge. To put it differently, participation in shared knowledge construction mediated by

technical and/or psychological tools provides learners with support that enables higher potentiality of cognitive growth and appropriation of the newly shared and co-constructed knowledge (Lantolf 2000). In the same line of thought, Jonassen et al. (1995) argue that the process of articulating our thoughts and sharing ideas and perspectives with others, as well as arguing and defending our own perceptions, engages us in a process of knowledge construction.

One of the important processes of knowledge construction is collaborative meaning construction. Through this process learners externalize, articulate, and negotiate alternative perspectives, including reflections on the meaning of concepts put forward by the tutor and peers. In this process students give prominence to conflict and negotiation processes, critically discuss information, elaborate on arguments, and explore multiple perspectives; knowledge and opinions can be reconstructed and expand students' understandings of specific concepts or problems. Thus meaning construction process can be seen as an important process for effective language learning.

2.2. Socio-constructivism in online environments

From a socio-constructivist perspective, researchers (Lapadat 2002, Hampel & Hauck 2004) suggest that new multimodal online conferencing systems may be particularly suited to provide socio-cognitive support and mediated social interactions. Studies have been carried out to investigate the types and patterns of interaction and report the increase in the quantity of interactive participation. Hampel & Hauck (2004) argue that audio-graphic conferencing facilitates increased levels of collaboration and participation among learners. Zahner, Fauverge & Wong (2000) provide evidence that audio-graphic conferencing is effective in supporting collaborative learning. Also, Schweinhorst (2004) stresses that audio- and video-conferencing systems allow students to interact and negotiate meaning as well as rehearse their oral skills.

It is also suggested that the modes and affordances of the media influence the way learners collaborate and interact to negotiate meaning and co-construct knowledge. Harasim (1987) explains that the multimodality of online interactions led to the creation of new types of interaction which reflect the features of constructivist learning environments. Salaberry (2000) emphasizes that the new multimodal technologies create a new environment with different features for the exchange and construction of knowledge. Moreover, it is argued that the way learners make use of the affordances of these multimodal tools influences the shape of interaction in terms of quality and quantity. Lamy points out that 'The shaping that takes place through these mediational tools is iterative: the tools help create the learning, and in turn the learner shapes these tools, which further shape the learning and so on' (2007: 386).

However, due to the novelty of this technology few studies are being conducted on the quality of online interaction and even less on their socio-constructivist dimension. In the early days of the implementation of this technology, Erben (1999) states that audio-graphic conferencing remains under researched. Furthermore, Anderson & Kanuka (1998), Sudweeks & Simoff (2000), and Sudweeks (2004) point out that the existing studies offer no empirical evidence which supports the claims that online interactions generated within synchronous conferencing environments promote collaborative co-construction of knowledge. Sing & Khine (2006) explain that current studies are generally based on quantitative ways of measuring participation. The results obtained through quantifying participation and interaction seem collectively to have caused us to lose sight of the point that not all interactions are conducive to constructive collaboration and that quantity does not guarantee quality. So the view which says that interaction is important does not however hold that all forms of interaction are equally productive for socio-constructivist language learning.

So far, researchers have focused on the impact of synchronous audio-graphic conferencing on participation opportunities; however, we have little knowledge about the extent to which the actual dynamics in this particular online environment meet the theoretical socio-constructivist expectations. It makes good sense, therefore, to want to try to understand the contribution of the emerging social interactions to meaning construction. My assumption is that it is this sort of relationship between interaction and its impact on socio-constructivist learning outcomes that needs to be established for a better understanding of the teaching/learning phenomena in audio-graphic conferencing environments.

In sum, learning is a process of socially negotiated construction of meaning. The process that I intend to study is the construction of meaning through collaborative interactions. From a socio-constructivist point of view, my interest is, hence, on knowledge construction process; that is, students' attempts to arrive at a shared understanding of concepts about language use and hence meaning making by explaining ideas, discussing alternatives, and arguing view points (Scarmadalia & Bereiter 1996, Roschelle & Teasley 1995).

In the light of this background, I raise the following question about the extent to which socio-constructivist aims of promoting social interactions for the realization of the collaborative construction of meaning are achieved in audio-graphic conferencing:

To what degree can interactive patterns over audio-graphic synchronous learning networks contribute to socio-constructivist learning?

3. Methodology

3.1. Models of analysis

Research on synchronous interactions in supporting knowledge construction processes is sparse and the analytical models for examining online interactions are mainly designed for asynchronous discussions. In this line, Anderson, Rourke, Garrison & Archer raise the following question: 'the question that remains is how this task of improving our understanding of such online interactions can be framed' (2001: 124).

Gunawardena et al. (1997) argue that higher forms of learning are socially mediated and co-constructed in collaborative interaction and mutual sharing of information. They propose the interaction analysis model to examine the process of social construction of knowledge. The model elucidates how participants can arrive at a higher level of critical thinking through different stages of interaction with peers. These stages are (a) sharing/comparing of information, (b) discovery of dissonance and inconsistency, (c) negotiation of meaning/co-construction of knowledge, (d) testing and modification of proposed synthesis, and (e) agreement/application of newly constructed meaning. The model explains thoroughly the different stages of the social knowledge construction, hence the need to use it to analyze my data. Phases (a) and (b) are the lowest stages of knowledge construction. Phases (c), (d), and (e) correspond to the highest stages of knowledge constructions where students use high forms of thinking (reasoning, critical thinking and depth of processing). However, this model offers only a partial description of socio-cultural constructivist learning processes in the sense that it does not describe higher forms of thinking. It provides just a classification of these processes. It is argued that learners engage in knowledge construction at a deep level when they use high forms of thinking. It is further argued that when we describe higher forms of thinking, only then we can assess the socio-constructivist dimension of learning (Hopkins et al. 2008). To describe higher forms of thinking, I decided to use Bloom's (1956) taxonomy. The taxonomy has been used extensively by different researchers for the examination of the promotion and the development of higher forms of thinking. It falls into three parts or overlapping domains:

cognitive, affective and psychometric domains. However, my analysis draws on the cognitive domain only.

Students' interaction processes are coded based on the five phases of knowledge construction proposed by Gunawardena et al. (1997). We analyze hence the social interaction processes focusing on how students are able to share and construct knowledge interactively through articulating opinions, thoughts, and beliefs, accepting and/or rejecting other students' contributions, arguing against others' contributions, defending their own contributions, applying others' perspectives, or modifying and replacing others' perspectives.

To attribute students' contributions to one or more than one of the phases of knowledge construction, the data is coded independently by two coders and the level of agreement is measured to ensure reliability. We do the same thing to select the abstracts that we use for illustration.

As stated above, the goal of this paper is to understand how the online tools mediate these transformations as students engage in collaborative knowledge construction. In our research contexts, students use different facilities: audio, chat, and vote. As such, I transcribe the audio and chat files. I use tables to represent the facilities used by the participants to interact. The first column represents the use of the audio channel. The second column is used to represent the use of chat. The third column represents the use of the vote facility.

3.2. Data collection

My research project investigates the participation patterns and the knowledge construction process of sixteen UK Open University students who use Lyceum. The maximum number of participants of each group is 8. For aims of credibility and objectivity, I need to observe more than 8 students, and hence the choice of two groups.

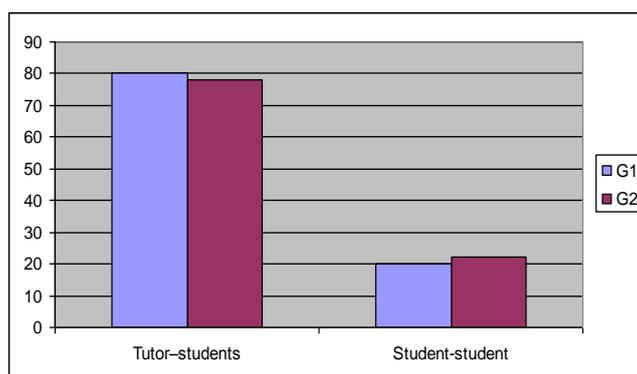
Lyceum provides multiple synchronous audio channels as well as synchronous chat and several shared graphical interfaces.

Data is collected via audio and video recordings of online sessions of adult OU higher proficiency learners learning French online. I observed two groups of OU students who are taught by the same tutor. I recorded four sessions with each group from two selected months during the semester. Each group had two sessions per month. Each recording is of approximately one hour and a half.

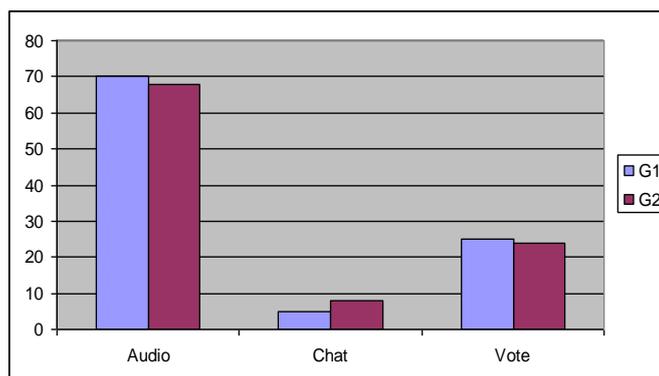
Recordings are conducted with the aid of Lyceum for sound recording and Camtasia (a piece of commercial software) for screen recording.

4. Analysis of the data

Before examining knowledge construction process, I decided to examine the direction of interaction and the modes of communication used by the participants (audio, chat and/or vote).

Figure 1: Direction of interaction

An examination of the direction of interaction shows the existence of two kinds of exchanges: exchanges which are exclusively teacher-student (80%) and exchanges which are exclusively student-student (20%). In small group work, learners are sent into separate rooms where everybody can get dialogue practice in French. It seems interesting to analyze them separately.

Figure 2: Use of mode of communication by students

It is clear from Figure 2 that students very seldom use chat (G1: 5%, G2: 8%). They rather use the audio channel (G1: 70%, G2: 68%) and the yes/no or vote button (G1: 25%, G2: 24%).

The impact which this distribution may have on knowledge construction process is described separately in the following sections. Tutor-student exchanges are first analyzed followed by student-student exchanges.

In the following section, I query whether the recorded online interactions reflect any opportunities for the process of collaborative knowledge construction to take place. To do so, each interactive turn is assigned to one or more of the phases of Gunawardena et al.'s model and then to Bloom's taxonomy.

4.1. The implementation of Gunawardena et al.'s model and Bloom's taxonomy

4.1.1. Tutor-student exchanges

Figure 3 and 4: classification of learners' interactions into phases of knowledge construction according to Gunawardena et al.'s model

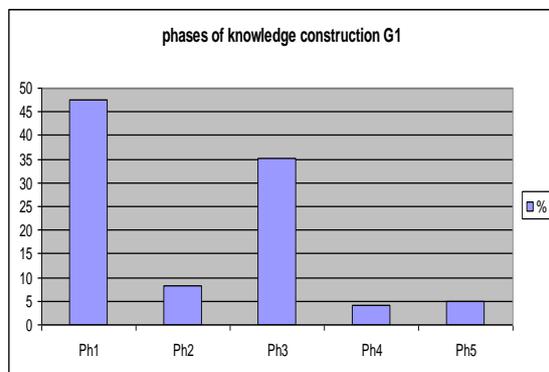


Figure 3

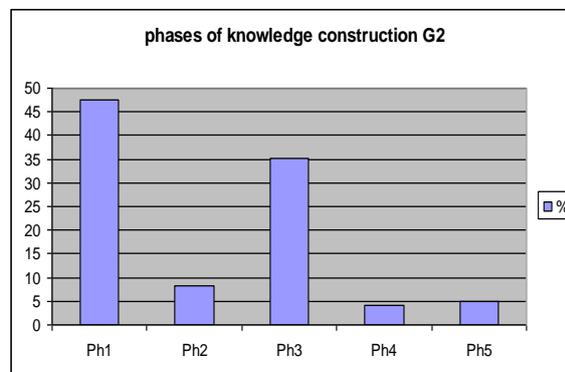


Figure 4

Figure 5 and 6: Distribution of thinking skills in the phases of knowledge construction (CPM: comprehension, APP: application, ANA: analysis, STH: synthesis, EVA: evaluation)

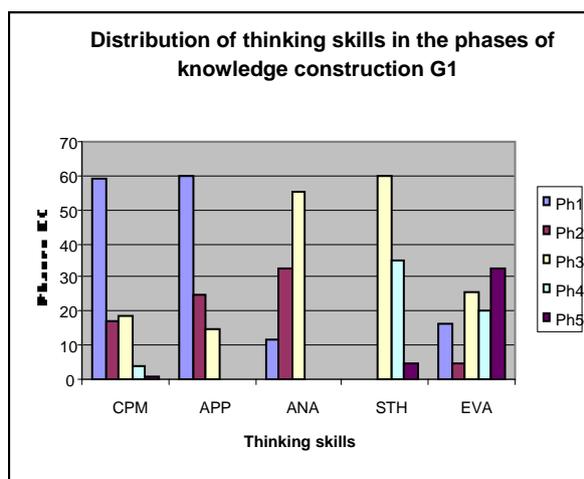


Figure 5

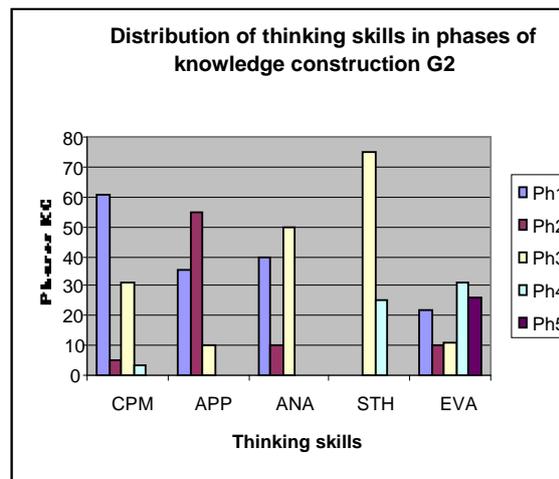


Figure 6

The percentages in Figure 5 and Figure 6 represent the total of thinking skills used by students to perform each phase of knowledge construction. For instance in G1, the low thinking skill comprehension is used 61% to realize (Ph1), 5% to realize (Ph2), 31% to realize Ph3, 3% to realize (Ph4), and never used to realize (Ph5).

The results suggest similar tendencies between groups towards giving/sharing substantial information (Ph1) and negotiation/construction of meaning (Ph3). Discussions display high percentages of (Ph1) followed by (Ph3). The second table shows that (Ph1) is at a basic, as well as at a high level of thinking. Students use mainly the low thinking skills comprehension (G1: 60%, G2: 58%) and application (G1: 60%, G2: 35%), which is expected, since they mainly express their opinions and describe their experiences. However, surprisingly they use higher forms of thinking analysis (G1: 40%, G2: 10%) and evaluation (G1: 15%, G2: 10%), even if the percentages are very low. As far as knowledge construction

is concerned (Ph3), the first group uses a wide range of thinking skills. They are engaged more or less equally in basic as well as high levels of thinking: analysis (G1: 55%, G2: 50%), synthesis (G1: 60%, G2: 75%), and evaluation (G1: 21%, G2: 25%). The second group uses less high order thinking skills than the first group. They represent 26.47%, which is quite good in exchanges where the presence of the tutor is overwhelming.

So students mainly adopt low thinking skills for providing information and stating agreement with what has been said in the previous turns. Furthermore, students use high thinking skills to explain, clarify, question, check and challenge information.

Other than sharing/comparing of information and attempts towards knowledge construction, both groups produce low percentages of (Ph2), (Ph4), and (Ph5). The low frequency of (Ph2) implies that students tend to share information with the tutor, negotiate meaning and accept it without challenging it. Students' opportunities to engage in the process of discovery and exploration of dissonance are very scarce. This observation remains true as far as the fourth phase is concerned. Moreover, both groups show reluctance to test and modify the proposed synthesis and apply newly constructed knowledge. The low percentages of (Ph4) and (Ph5) were expected since it is not common to assimilate and apply new knowledge so rapidly. The assimilation and integration of new knowledge are social cognitive processes that require time. The results sustain this interpretation. The recorded students' meta-cognitive statements show that knowledge construction occurs over time after the end of previous sessions.

However, students engage in high level thinking throughout the two last phases of knowledge construction. They mainly evaluate their ways of thinking and assess the co-constructed knowledge.

I conclude that students engage in the process of knowledge construction at a deep level. Possibly the omnipresence of the tutor does not have a negative effect on creating opportunities for learners to be involved in deep information processing.

In what follows, the results from the analysis of student-student exchanges are considered.

4.1.2. Student-student exchanges

Figure 7 and 8: classification of students' discourse into phases of knowledge construction according to Gunawardena et al.'s model

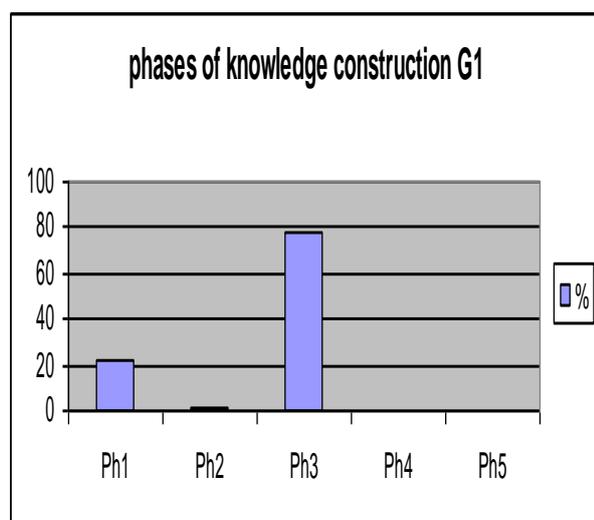


Figure 7

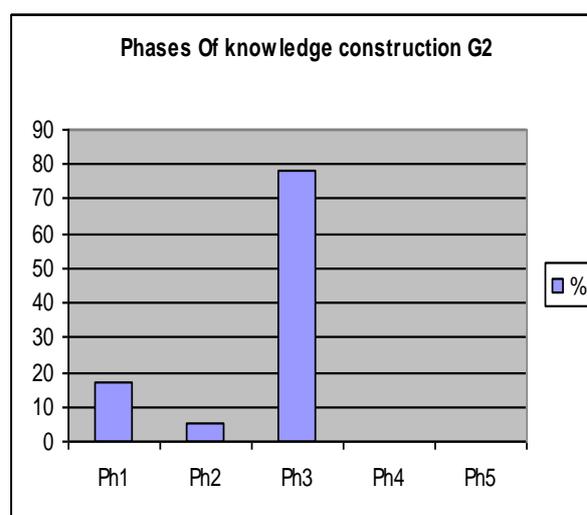


Figure 8

Figure 9 and 10: Distribution of thinking skills in the phases of knowledge construction (CPM: comprehension, APP: application, ANA: analysis, STH: synthesis, EVA: evaluation)

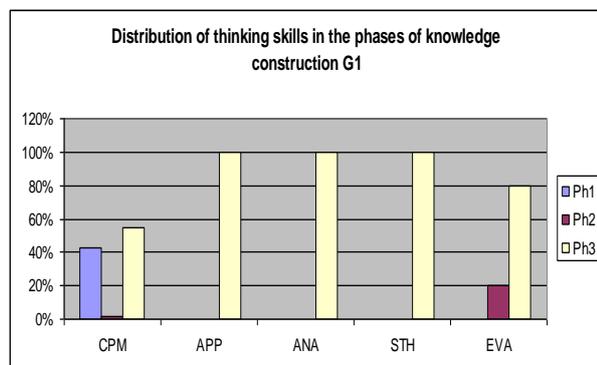


Figure 9

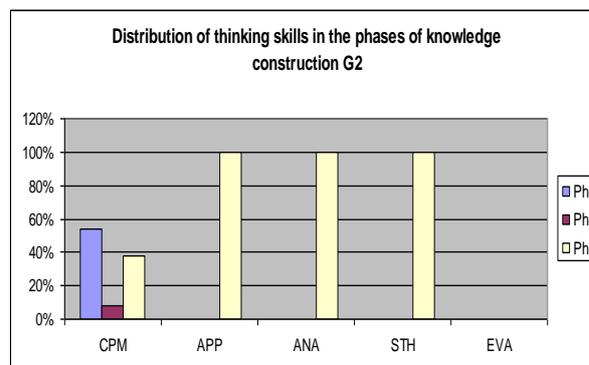


Figure 10

The analysis of student-student exchanges shows more collaborative efforts as students tend to concentrate on eliciting information from others at the start of exchanges and responding to explain, clarify and justify their answers. There are few instances of interaction between students that involve inconsistencies or contradictions in information and/or ideas that result in a new or changed perspective. However, there are some instances of challenges and disagreement that serve to follow up the meanings of previous turns which foster the process of negotiation of meaning.

Responses by students are likely to take the form of (Ph3/A1), (Ph3/A) and (Ph3/D) that convey efforts to provide information and convey meaning which suggest greater efforts to support each other in the learning process. Moreover, the three sub-phases indicate participants' involvement in meaning negotiation, as the shared information is questioned, checked, clarified, and challenged. Student-student interactions rarely go beyond (Ph3) and never beyond (Ph4), in spite of the fact that students use a wide range of higher order thinking. They are more engaged in higher thinking than lower thinking. This implies depth of information processing.

4.2. Extracts' analysis

In the following section I will analyze some extracts. This analysis affords a finer interpretation of the information sharing phase and negotiation of meaning in exchanges as well as the use of high forms of thinking. Furthermore, the analysis helps to determine whether interaction is influenced by the medium or other factors.

A priori, the results of the analysis show that phases of knowledge construction do not follow a linear pattern. Therefore, some extracts are analyzed to highlight the nonlinearity of this process and its possible implications.

4.2.1. Extract 1

There are some exchanges which do not go beyond the first phase and other exchanges where students start by sharing information and then pass immediately to higher levels of thinking and knowledge construction reporting on their cognitive change.

Turn Audio	Audio file
1	P. Moi je dois je dois dire que franchement je l'ai trouve très difficile bien que je trouve le sujet c'est normal très intéressant parce que je connais beaucoup de maghrébins et j'ai passé beaucoup de temps au Maghreb donc c'était très très intéressant pour moi de parler avec eux et d'avoir leur opinion sur le sujet mais moi je trouve le TMA très difficile parce que euh il faut d'abord faire un grand travail de synthèse être synthétique et bon pour moi c'est très difficile par ce que ca c'est un style d'étudier très différent du style Italien ou on peut parler et parler enfin j'étais très contente d'avoir réussie a l'enregistrer avec la nouvelle technologie qui est pour moi franchement un miracle
2	J. Oui je l'ai trouvé très difficile mais aussi très intéressant surtout en ce qui concerne le lien entre ce qu'on a appris sur le thème la France accueil et écueil et bien qu'en Angleterre nous vivons dans une société multiculturelle le TMA a provoquée des expériences des aspects différents de l'immigration en particulier en ce qui concerne les œuvres d'art je l'ai trouve très intéressant parce que bien qu'il y a un musée consacre aux-œuvres œuvres d'art des immigres j'ai euh j'ai rendu compte ce n'ai pas tout a fait de regarder les ouvres d'art il faut il faut aussi entendre et comprendre les expériences des immigres pour vivre ensemble je crois pour le sujet de la technologie je préfère en général utiliser la technologie démodée c'est à dire les bandes enregistrées parce que euh pour le TMA précédent j'ai gaspillé du temps beaucoup de temps et j'ai beaucoup de mal a rendre ma fiche petite pour le TMA

In these extracts, students are invited to reflect upon their experiences and give their opinions. At this stage, communication is unidirectional, as students are more occupied with providing information at some depth through describing and explaining their experiences and understandings, agreeing with and corroborating other students' contributions. This is to say that there is no exchange of information.

The students go beyond description to evaluate their experiences, their ways of thinking and the content of teaching itself. It seems that the switch to high level of thinking causes the switch of discussion from Ph1 to Ph5.

Student P (Turn: 1) responds orally to the tutor's elicitation by first stating her opinions and pointing out the difficulties she encountered. She engages in a deep reasoning and high level of thinking when she tries to evaluate the content of the exam and assess its difficulty. She justifies her answer by providing examples and assessing the exam against her own experience and her own ways of thinking. So, student P conveyed rather implicitly her awareness of her cognitive change and knowledge building as a result of the work on this exam. Contrary to student P, student J (Turn: 2) states explicitly that her understanding of concepts has changed. She starts by stating briefly her opinions then makes a meta-cognitive statement acknowledging that her understandings of the new concept and ways of thinking have changed as a result of the preceding session and the exam. She justifies such a statement by deconstructing, assessing and working out interpretations of the values and ideas conveyed by the materials.

So, student J and P engage in high levels of thinking and become critical and evaluative of their performances and capacities and the content of learning. Consequently, discussion passes from the first level to the fifth level of knowledge construction.

4.2.2. Extract 2

I note that the following examples 2 and 3 highlight the switch between more than three phases.

Turn Audio	Audio	Chat
1	T. C'est toujours mon expérience à moi lorsque je suis en France que j'ouvre que je lis les journaux français de comparer toutes les pages sur la culture à ce que nous avons en Grande Bretagne en Grande Bretagne si on lit le Times the	P : oui

	Guardian the Independent il y a parfois une page sur la culture un éditorial dans les journaux français je vous le promets il y en a encore davantage si vous avez l'occasion d'aller en France ou d'avoir dans la main de la presse française prêtez attention à cela Jn est ce que tu veux faire un commentaire à cet égard Jn	
2	J. Pas tellement mais quand je suis en France j'essais toujours de lire le Figaros le monde j'ai vu souvent les pages de la culture	
3	T. Oui absolument il y a bien cela dans le Figaro dans le monde dans les grands journaux même dans les petits journaux à l'échelle départemental P est ce que tu as remarqué cela P	
4	P. Oh oui tout a fait aussi dans les pays francophones qui ont le même euh qui partagent la même considération pour la culture il y a toujours beaucoup d'articles sur les événements les concerts les expos comme ca	
5	T. Oui c'est exactement cela P beaucoup d'articles sur les événements sur des expos des concerts les derniers livres le cinéma par exemple tout à fait merci beaucoup mon quatrième point ici porte sur les sommes investies par les entreprises dans le mécénat plus de 50 million d'euro par an le mécénat est ce que vous connaissez ou vous comprenez ce mot cliquez oui on non svp	
6	Tn. Je ne sais pas vraiment sur la France ni qu'est ce qu'ils font là-bas mais ici a il y a une petite organisation la société sur l'Opéra et je crois que peut être qu'il y a des pratiques culturelles en amateur pareilles en France	
7	T. Oh absolument il y en a en France beaucoup plus qu'en grande Bretagne en faite même à petite échelle a nouveau dans des petites villes il y aura souvent dans une maison de la culture un club de philatélistes une corole un groupe de musicien un groupe folklorique cela se fait beaucoup en France non seulement par des enfants et des personnes âgés mais aussi par des personnes adultes qui aiment bien pratiquer leur passe temps leur hobby non seulement de façon indépendante mais également de façon collective est ce que certains ont des exemples ou veulent commenter sur ce point la cliquez oui ou non svp	
8	A. En faite moi en écoutant tout ca je euh je ne savais pas que c'était le cas pour l'Angleterre que les anglais étaient aussi réticents si je peux dire à toute découverte de nouvelles cultures ou de euh de des arts et en faite je voulais demander aux natives si elles pensaient ou elles savaient quelle était la cause de cette attitude	
9	Jn. Oui je crois que l'Angleterre investit vraiment plus dans les sports que dans la culture et c'est le sport que les gens aiment beaucoup et veulent que et que dans les sports qu'on à l'argent	
		1. J. Je pense que les anglais regardent la culture comme quelque chose d'élitiste
11	P. Oui je trouve que les commentaires des autres est tout à fait exacte mais la culture c'est une chose qui est vit exactement comme les middle classe c'est pas une chose enseignée dans les écoles de très petites je pense que c'est une chose la culture en général c'est quelque chose qui est comment on peut dire délégué dans un certain groupe de personne pas comme en Italie ou en France ou la culture est vraiment fait partie de la vie	
		2.T. Je ne veux absolument pas dire que les anglais sont incultes ou n'aiment pas les arts Sorry !!!!
12	T. Absolument P voila qui est extrêmement bien expliqué en grande Bretagne il	

	y a cette idée que la culture est très middle classe alors qu'en France en Italie en Espagne en Portugal aussi it involves all the society pardon je me suis mis à parler en anglais ca m'arrive parfois oui T	
13	Jn. C'est seulement la où j'habite il y a un petit musée mais il y a beaucoup qui y vont les week-ends pour regarder des choses assez simples et aussi des clubs de vente toutes les années des expositions à laquelle tout le monde peut venir et ca coute seulement une livre et il y a beaucoup beaucoup de monde qui vendent à cette exposition	

The tutor tries to clarify the meaning of the concept of culture and invites students to explain, clarify, corroborate, challenge and negotiate ideas and concepts with him. J (Turn: 2) corroborates his explanations by providing examples from her personal experience and explaining them. Her contribution moves discussion down to the phase of sharing and comparing information (Ph1).

P (Turn: 4) tries to corroborate the explanations provided by the tutor. She draws on her experience and cultural background to break down the concept of culture into different concepts, compares the identified concepts and generalizes. P engages in a higher order of thinking (analysis and evaluation) trying to justify her reasoning by assessing the new knowledge against her previous knowledge. So, P's contribution brings the discussion back to (Ph3) which then progresses a step further to (Ph4). The tutor accepts P's explanation and attempts to work out a shared synthesis when student Jn, who corroborated the tutor's explanations in (T: 1), engages in a process of argumentation challenging the new synthesis. Jn becomes more aware of the differences in views and interpretations and tries to assess this final synthesis against her own experiences (Ph4) and finishes by rejecting it (Ph2). So Jn's contribution brings communication down to (Ph2) conveying a need for another direction for discussion. As a response, the tutor elaborates on Jn's arguments by making further clarifications and brings communication up to (Ph3).

I deduce that engagement in (Ph4) of knowledge construction does not necessarily lead to the acceptance of new knowledge, as is the case in this example. I distinguish two possibilities. First, new knowledge creates conflicts and inconsistencies and students reject it and relaunch the process of negotiation of meaning. Second, students accept and integrate the new knowledge, as is the case with student A (Turn: 9). She makes a meta-cognitive statement asserting that her knowledge changed as a result of this conference. Consequently, communication passes to (Ph5). However, surprisingly, she invites British students (Jn and J) to share information and negotiate again the new information, thus re-launching the process of negotiation and throwing back communication to (Ph1) and then to (Ph3). One possible interpretation is that students give critical consideration to the proposed synthesis by re-questioning, re-checking, and challenging it. This implies that they are engaged in a deep process of knowledge construction rather than merely accepting the shared information.

The comments of student A activate highly intense and heated discussion where all students are attracted to contribute. Jn (T: 10) accepts the tutor's explanation, assesses it against her cultural background and corroborates it. J (chat: 1) writes a comment in the chat box where she evaluates the concept of culture in the British context. P (Turn: 11) corroborates their explanations, elaborates on their ideas and evaluates the new concept by deconstructing it to further components. Jn, J and P are thereby engaged in the process of meaning negotiation (Ph3/A/C) at a high level of thinking bringing communication up to (Ph3) and then to (Ph4). However, Tn (turn: 13) challenges their explanations and engages in a process of argumentation by investigating alternative viewpoints. Again, communication moves down to (Ph2).

I may say that the interactional patterns of students reflect the characteristics of exploratory talk (Wegerif & Mercer 1997) as they cooperate to share information and

contribute critical responses that prompt efforts from others to justify or explain views. Moreover, the discussion appears to provide what Newman, Griffin & Cole refer to as the ZPD which ‘evolves from the interaction between people with different points of view on the same situation and when successful, results in the appropriation of one view by the other’. (1989: 93).

In sum, students actively participate through formulating and challenging new ideas, testing them against existing cognitive schemata and personal experience, and then constructing their understandings of the concepts. Moreover, there is evidence of exploratory talk, which is a model of higher order thinking in which students engage critically but constructively with each other’s ideas.

4.2.3. Extract 3 (student-student exchanges)

It is worth noting that the students use only the audio channel to discuss. They are sent into separate rooms to work collaboratively without the tutor. They come back to the main room to work again with the tutor (turn: 20)

Tt	Audio
1	Jn. Mais qu’est ce que vous pensez que cette phrase veut dire
2	P. Bon je pense personnellement que ca veut dire que il faudrait avoir de la conscience dans le domaine de la science sinon elle va être elle pourrait être une ruine peut être pour la société pour l’éthique morale et vous qu’est ce que vous pensez
3	P. Jn qu’est ce que tu pense de ce sujet
4	Jn. Du point de vue anglais je trouve ce sujet très pertinent euh parce que récemment dans le parlement le gouvernement a mis en question certains lois en ce qui concerne par exemple human civilisation and Biology et je pense qu’il y a un élément de cette question dans les décisions du gouvernement
5	J. Et vous vous pensez tous que c’est seulement dans le monde des génétiques qu’il faut avoir des barrières ou il y a t il aussi des autres thèmes dans la science avec qui il faut faire attention
6	P. Euh bon oui je pense que je suis d’accord qu’il faut avoir quelques lignes de marcation il faut c’est pas possible de faire tous les expériences c’est pas possible de faire tous les choses que la science peut faire je pense dans le point de vue éthique et moral je pense que aujourd’hui la science fait des choses qui sont vraiment immorales
7	J. Oui on peut dire que beaucoup d’écrivains dans la science ont le résultat de l’accident les résultats et donc si on pense seulement dans l’ethic et les morales peut être que on manquerait des réussies que peut tout le monde peut profiter avant
8	P. Mais vous êtes sur que vous allez utiliser le plan dialectique alors parce que je répète pour moi c’est très difficile comprendre ce que je dois faire
9	J. Si on regarde le plan analytique c’est comme le problème scientifique je crois on recherche les causes du problème et les conséquences et donc on propose une hypothèse ou une solution pour le problème mais ca c’est quand on fait des recherches politiques quand on discute une question et l’autre le plan progressif ca demande pas du tout un avis personnel seulement que on recherche tout les documents et donc je crois qu’il faut exclure les deux et donc il faut qu’on utilise le plan dialectique
10	P. Alors je vous demande qu’elles sont les idées que vous avez pour la thèse l’anti-thèse comment planifier cet euh hypothétique TMA
11	J. Si on choisi par contre le plan analytique peut être on peut citer les fins euh les faits donc euh on a la situation vis-à-vis les politiques scientifiques et puis peut être les causes le fait que les découvertes scientifiques sont très nombreuses et il est nécessaire de décider ce qu’on veut faire avec les informations les découverts et si s’ils sont bon pour la société et les conséquences sont les fait est ce que le gouvernement font les décisions les bonnes décisions en ce qui concerne la science
20	T. Oui P (students come back to the main room)
21	P. Bon je vais essayer parce que franchement c’est un sujet très difficile mais vraiment cette fois ici c’est terrible mais donc nous avons conclu que peut être ca veut dire qu’il faut peut être limité le

	domaine de l'expérimentation dans le domaine de la science parce que c'est pas vrai qu'on puisse faire tout ce qu'on veut faire et qu'il faut démarquer il faut avoir une ligne de marcation
27	P. Merci beaucoup ca était très utile pour moi merci

In this example, students are invited to work out collaboratively an essay around the topic of technology and conscience. The focus is on the process of refining previous knowledge with the aim of creating a new consensus and applying it on the basis of what is shared and learnt in the session. Students discuss and debate points of view in order to reach understanding or agreement about the meaning of the target concepts and their interpretations. They invite each other to negotiate through inquiring (Turns: 1, 2, 3). They work collaboratively by confronting and comparing the target concepts, deconstructing them into further concepts, explaining and clarifying through exemplifying and establishing cause and effect relationships, corroborating each others' explanations, evaluating and elaborating by building on each others' ideas (from Turn: 1 to Turn: 5). Student P (Turn: 6) takes the process of collaborative negotiation a step further by transforming the sentence into a question and inviting her peers to negotiate this question and the proposed answer. Hence, students engage in the process of critical inquiry where examples and concepts are critically analyzed through evaluating them against each other involving logical reasoning. From a socio-cultural constructivist perspective, the results suggest that participants are involved in the exchange and comparison of individual interpretations of concepts and hence forming a zone of proximal development for supporting each other during interaction. This pattern observed in both groups suggests greater collaborative efforts to actively attend to the meanings and implications of others' contributions and further develop the topic of discussion through reinitiating turns as opposed to only focusing on their own contributions.

Then, students engage in the same process of collaborative negotiation; propose, inquire, clarify, check, and justify. Moreover, they engage in a process of argumentation (Turn: 7) and counter argumentation (Turn: 9) whereby they use their newly constructed knowledge to justify their answers, check their explanations and validate or challenge proposed ideas. Jn (Turn: 9 and Turn: 11) applies the definition of the different plans learnt in the previous session to check her peers' propositions and to raise the possibility of changing the direction of discussion by considering other alternatives. This counter-argumentation engages Jn to consider all the possible alternatives, checking them against the identified concepts and using the newly constructed knowledge as criteria of assessment. Hence, discussion moves down from (Ph5) to (Ph3) and then up to (Ph4) and (Ph5) of knowledge co-construction.

Overall, there is strong evidence that students are engaged in the process of knowledge co-construction using high forms of thinking such as: analysing (deconstructing the sentence into different concepts and transforming the sentence into a question), evaluating (checking, questioning and justifying information) and synthesizing (organization of ideas and elaboration of a plan). Students work collaboratively by confronting concepts, explaining, arguing and evaluating newly constructed knowledge with respect to the goal of the task. These actions are part of the process of knowledge negotiation, which serves to reach agreement about the concepts to use for the realization of the target task.

However, students could reach agreement after the intervention of the tutor who invites them to comment on their discussions and synthesize the shared points and hence engages them in a higher level of thinking.

This is seen as an opportunity for students to revise and restructure their ideas and arrive at a better understanding of their discussion. The students work collaboratively with the tutor and succeed at focusing and refining discussion so that the conversation progresses

beyond information sharing to knowledge construction and especially application and integration (Ph5). This is evidenced by P's contribution (Turn: 27), who makes a meta-cognitive statement illustrating that her understanding has changed.

I conclude that until internalization occurs, performance must be assisted. Vygotsky explains that teaching 'is good only when it awakens and rouses to life those functions which are in a stage of maturing, which lie in the ZPD' (Vygotsky 1956: 278).

5. Interpretation of the results and findings

This study examined the impact of online interaction on supporting the collaborative knowledge building process, which is held to be characterized by the presence of active participation, collaborative information sharing and negotiation/co-construction of knowledge.

The analysis of the corpus shows the existence of all of the phases with different proportions. Despite the fact that most of discussions are of a sharing and comparing of information, there is evidence of collaborative knowledge construction in tutor-student and student-student exchanges. Students are involved in higher forms of thinking, challenging and revising their ideas. The socio-cultural constructivist learning perspective assumes that knowledge building occurs during interaction which involves the sharing of multiple perspectives on experiences or concepts, and negotiation of individual interpretations (Vygotsky 1978, Wertsch 1985). The study provides evidence that students share information, analyze critically their own views and revise concepts in the light of conflicting ideas, as such creating a zone of proximal development where the process of knowledge construction is supported by peers' and tutor's scaffolding.

Furthermore, there are instances of interaction in tutor-student and student-student exchanges that involve inconsistencies or contradictions in information and/or ideas. Students try to pursue an understanding of the contradictory information and engage in the process of negotiation where they follow a pattern that includes clarification, explanation and challenge of the inconsistent information. Discussions reflect more closely the characteristics of exploratory talk as students cooperate to share information, and contribute critical responses that prompt efforts from others to justify or explain their views. In this realm of thought, Von Glaserfeld (1989) suggests that this type of talk functions as sources of perturbation that lead to change in individual interpretations or experiences or concepts, and prompts debate of ideas. So far, this type of argumentation resulted in a new or changed perspective in tutor-student exchanges but rarely in student-student exchanges. Wegerif & Mercer (1997) suggest that knowledge is made more publicly accountable and reasoning is more visible in exploratory talk. It is observed that students discuss critically the proposed information (analysis), detect dissonance, elaborate on arguments (evaluation) and explore multiple perspectives based on relevant experience and literature (synthesis). From a socio-constructivist viewpoint, this phase is necessary because it prompts debate and reconsideration of ideas presented, which signals efforts at meaning negotiation and cognitive development (Pena-Shaff & Nicholls 2004).

Furthermore, there is evidence of exploratory talk, which is a model of higher order thinking in which students engage critically but constructively with each other's ideas.

The model of Gunawardena et al. (1997) describes the process of knowledge construction as a linear process. Hopkins et al. (2008) point out that the three upper phases of knowledge construction correspond to the use of higher forms of thinking. However, the analysis shows that the process is rather cyclical and that communication moves from (Ph1) up through higher phases as well as from higher phases down to lower phases using higher order forms of thinking. The use of higher forms of thinking engages students in a deep

processing of information where they analyze, re-analyze, synthesize, re-synthesize, evaluate and reevaluate information before internalization takes place. Students engage in a process of revising and refining information, implicating a switch of communication between the different phases of knowledge construction with the aim of validating or rejecting new information.

I conclude that the more students engage in a high level of thinking the more the process of knowledge construction moves to upper levels in a cyclical/spiral way at a deep level of processing and vice versa. Communication moves up and down between the different phases of knowledge construction before new knowledge is co-constructed and finally validated.

However, I could not find evidence that the audio-graphic conferencing supports interactive participation and the process of knowledge construction. Students use the chat box to write short answers when asked to do so by the tutor. They use it as an alternative to the audio channel whenever they encounter sound problems. They use the vote to convey compliance, acknowledgment or to ask the floor from the tutor. These results indicate a stronger tendency to use the audio channel than the other audio-graphic tools. The tutor uses the chat box to evaluate and elaborate on students' ideas to avoid interrupting students and to reinforce the new ideas. However, I could not find any evidence that students learn from the chat. This implies that the chat and the graphical tools provide a non-significant support for conversation for advanced students since they are highly proficient students and have the linguistic skills to communicate. Audio-graphic conferencing functions just like audio-conferencing where students have opportunities to practice their aural and oral skills. An interesting aspect is the fact that students could work collaboratively in separate rooms, which, as explained above, provides opportunities for information sharing and negotiation of meaning.

It cannot therefore be assumed that the learning process is supported by the audio-graphic system itself. There are several possible reasons that may account for the results obtained in this study. The analysis shows that instances of sharing and comparing of information are concentrated in the first activity (debriefing) where students are invited to reflect on their answers, whereas the upper four phases of knowledge construction mostly occurred during the main activity of the sessions where the tutor introduces a topic of discussion and invites his students to discuss and negotiate with him and/or together in small groups. The shift of topic and task engages students in different patterns of interaction where they focus either on information sharing or negotiation of meaning and the development of the topic of discussion.

So far, the analysis of teacher-students exchanges shows that students use higher order thinking skills to negotiate meaning. This process is strongly supported by the tutor's efforts to scaffold by involvement in mutual information exchange and negotiation. He shares responsibility with students for negotiation of meaning through engaging them in active linguistic and cognitive process. I conclude that the tutor tries to trigger discussion and facilitate high levels of thinking and knowledge construction by using explanation and clarification requests to invite learners to reason, justify, argue, explain and clarify.

This interpretation is sustained by the fact that communication rarely goes beyond (Ph3) and never beyond (Ph5) in student-student exchanges. Communication moves to upper levels of knowledge construction in tutor-students exchanges.

Finally, it can be seen that knowledge construction is in constant evolution based on social interaction and meaning negotiation and engagement in high forms of thinking.

6. Conclusion

The present work shows the value of adopting complementary theoretical and analytical approaches and urges the need to develop a model of analysis of online interactions which draws on cognitive and socio-constructivist theories of learning.

Finally, if we accept that socially constructed knowledge involves negotiation of meaning, co-construction of knowledge, and integration of that knowledge, then the conference under scrutiny, the tutor's style and task facilitated the collaborative process of knowledge construction.

Appendix

Turn Audio	Audio file
1	P. I must say that honestly I found it very difficult although I find the subject very interesting because it's normal know many North Africans and spent a lot of time in North Africa so it was very very interesting for me to talk with them and get their opinions on the subject but I think the TMA very difficult because we must first make a great work of synthesis and summary for me it is very difficult because it is different from the Italian learning style where we can talk and talk, finally I was very happy because I succeeded in recording it using a new technology which is really a miracle for me
2	Yes I found it very difficult but very interesting especially regarding the link between what has been learned about the theme of France though we live in England which is a multicultural society the TMA provoked experiences of different aspects of immigration in particular as regards arts I find it very interesting because although it is a museum devoted to art-works of immigrants I uh I realized this is not just about art, but we hear and understand the experiences of immigrants to live together I think concerning technology in general I prefer to use old technology like tapes because uh the previous TMA I wasted time and a lot of time I have difficulties reducing the size of my TMA

Turn Audio	Audio	Chat
1	T. It is always my experience when I'm in France I open and read the French newspapers I compare all the pages on that talk about to the newspapers we have in Great Britain in Great Britain if you read the Times the Guardian the Independent there is sometimes a page on the culture an editorial in the French newspapers I promise you there are still more if you have the opportunity to go to France or if you can have a French newsletter try to pay attention to this point J do you have a comment J	P : yes
2	J. Not really but when I'm in France I try always to read the Figaro the world I have often seen the pages of culture	
3	T. Yes this is absolutely correct in Le Figaro in the world in major newspapers even in small regional newspapers P did you notice this P	
4	P. Oh yes, quite as in francophone countries that have the same uh who share the same interest in culture there is always a lot of articles about the cultural events concerts exhibitions things like this	
5	T. Yes this is absolutely correct P lot of articles about the events concerts exhibitions on the latest books on cinema for example thank you very much my fourth point here relates to the amounts invested by companies in the patronage more than 50 million euros per year in the patronage do you know or do understand this word please click yes or no	
6	Tn. I do not really know about France nor what they do there but here there is a small organization for Opera and I think that maybe there are similar cultural practices in France	
7	T. Oh, absolutely there are many more in France than in Great Britain made even at a smaller-scale again in small towns there will often be in a house of	

	culture club of philatelists a corollary a group of folk musicians there is a lot in France not only by children and older people but also by adults who love to practice their hobby the hobby not only independently but also collectively do you have examples or do you want to comment this point, please click yes or no	
8	A. actually when listening to all this I did not know that this is the case in England the English were also reluctant to discover any new cultures and arts and I wanted to ask the natives if they thought they knew or what was the cause of this attitude	
9	Jn. Yes I think England is really investing more in sports than in culture and people like sport and want to give it money	
		1. J. I think that English people considers culture as something elitist
11	P. Yes I find the comments of others quite accurate but culture is something that is seen just as middle class is not something taught in schools of very small I think it is something culture in general is something that is how you can say concerns just a certain group of people not like in Italy or France where culture is really part of life	
		2. T. I definitely do not want to say that the English are ignorant or do not like the arts Sorry!!
12	T. Absolutely P "so there is very well explained in Britain there is the idea that culture is very middle class while in France Italy Spain Portugal as it Involves all the society I am sorry I started speaking English This happens to me sometimes yes T	
13	Jn. It is only where I live there is a small museum, but there are many who go there on weekends to look at fairly simple things and clubs that come to sell every year and exhibitions where everyone can come and it costs only a pound and there are many many people who sell at the exhibitions	

Tt	Audio
1	Jn. But what do you think this sentence means
2	P. Well I personally think it means that we must have some awareness in the field of science otherwise this would ruin society and moral ethics and you what do you think
3	P. Jn what do you think of this topic
4	Jn. From the British point of view I find this very relevant uh because recently the government in the parliament has questioned some laws regarding such human civilization and Biology and I think there is an element of this issue in the government's decisions
5	J. And you all think that only in the world of genetic that we should have barriers or are there also other topics in science with which we must be careful
6	P. well yes I think I agree we should set limits it should not be possible to make every experience it is not possible to do all the things science can do, I think from the ethical and moral point of view I think that scientists do many things that are really immoral
7	J. Yes we can say that many writers in science think of the results not just the accidents so if you only think in the ethic and moral may be that we may fail to discover good things that everyone can enjoy later
8	P. But you're sure you'll use the dialectical plan then because I repeat it once again it is very difficult for me to understand what to do
9	J. If you look at analytical plan it is just like a scientific issue we seek the causes and consequences of

	the problem and therefore we suggest a hypothesis or a solution for the problem but it this is when we do some research on politics and discussing a question and the other plan which is the progressive plan it does not require a personal opinion at all we need to look for all the documents and therefore I think we should exclude the two and we must use the dialectical plan
10	P. So I ask that `they are the ideas you have for the theory and anti-thesis how to plan this hypothetical TMA
11	J. If we chose the analytical plan we could talk and give examples and facts so we have the situation vis-à-vis the scientific and political causes and may be the fact that scientific discoveries are very numerous and it is necessary to decide what we want to do with the information discovered and if they are good for society and the consequences and whether the government makes the right decisions concerning science
20	T. yes P (students come back to the main room)
21	P. Okay I will try because frankly it is a very difficult topic this time it is really very difficult but then we concluded that maybe it means that we must limit the field of experimentation in the field of science because it is not true that we can do anything we want we need to set out red lines that scientific experiments must not cross
27	P. Thank you very much it was very useful for me thank you

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