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SOCIALLY ACUTE QUESTIONS

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Sisyphus — Journal of Education aims to be a place for debate on political, social, economic, cultural, historical, curricular and organizational aspects of education. It pursues an extensive research agenda, embracing the opening of new conceptual positions and criteria according to present tendencies or challenges within the global educational arena.

The journal publishes papers displaying original researches—theoretical studies and empiric analysis—and expressing a wide variety of methods, in order to encourage the submission of both innovative and provocative work based on different orientations, including political ones. Consequently, it does not stand by any particular paradigm; on the contrary, it seeks to promote the possibility of multiple approaches. The editors will look for articles in a wide range of academic disciplines, searching for both clear and significant contributions to the understanding of educational processes. They will accept papers submitted by researchers, scholars, administrative employees, teachers, students, and well-informed observers of the educational field and correlative domains. Additionally, the journal will encourage and accept proposals embodying unconventional elements, such as photographic essays and artistic creations.

Les Questions Socialement Vives (QSV) ou Socially Acute Questions (SAQ)

Introduction by *Laurence Simonneaux and Chantal Pouliot* (Editors)

Legardez et Simonneaux (2006) ont proposé le terme 'Questions Socialement Vives' – (QSV) en anglais 'Socially Acute Questions' (SAQ) – pour décrire des questions complexes ouvertes controversées et intégrées dans des contextes réels. Ces questions sont au cœur du problème de l'enseignement et de l'apprentissage dans un monde incertain, influencé par le développement des technosciences et par les crises environnementales et sanitaires. Ces questions situent la controverse sociale et scientifique, la complexité, le renforcement de l'expertise, l'évaluation de la preuve, l'incertitude et le risque au cœur du processus d'enseignement-apprentissage.

Les questions sont perçues comme «vives» lorsqu'elles sont controversées dans les trois domaines suivants:

- dans la société, elles engendrent des débats. Il y a souvent une couverture médiatique de ces questions et, par conséquent, les élèves/étudiants peuvent en avoir des connaissances superficielles ;
- dans la recherche et dans le monde professionnel ;
- dans la classe, ils sont aussi souvent perçus comme 'vifs'. Dans cette situation, les enseignants se sentent souvent en difficulté pour les traiter en classe, car ils ne peuvent pas seulement compter sur la seule utilisation de faits scientifiques stabilisés et ils craignent de ne pas être en mesure de gérer les réactions des élèves. Par conséquent, certains enseignants choisissent de ne pas les enseigner ou de les neutraliser ('pour les refroidir') tandis que d'autres, au contraire, décident de les activer ('pour les réchauffer'). Il semble que les enseignants se positionnent selon le 'degré de vivacité' qu'ils perçoivent et le 'risque d'enseigner' qu'ils peuvent tolérer.

Les QSV sont des questions interdisciplinaires. Elles ne se rencontrent pas seulement dans les 'sciences dures' et dans les sciences humaines et sociales, mais aussi dans le monde social et professionnel. De nombreux acteurs différents participent à la production de savoirs sur ces QSV. Il s'agit notamment des scientifiques, des citoyens, des philosophes, des professionnels et, même, des lanceurs d'alerte. Les décisions prises sur les QSV ne peuvent être fondées uniquement sur les savoirs scientifiques, mais

doivent également prendre en compte les implications sociales, les idéologies et les valeurs.

Nous considérons que l'enseignement des QSV a une dimension «performative». Il est nécessaire de sensibiliser à l'importance vitale de la réflexivité sur la modernisation (Beck, 2001) par le biais de 'l'éduc-action' (Simonneaux & Simonneaux, 2017), c'est-à-dire une éducation axée sur la façon dont nous fonctionnons et agissons collectivement et individuellement. Dans quelle mesure cette réflexivité doit-elle être développée? L'éducation devrait-elle faire l'objet d'une réflexivité sur les savoirs impliqués ou permettre aux élèves/étudiants de générer leurs propres connaissances sur les risques potentiels ? L'objectif de l'éduc-action est d'encourager non seulement la participation des élèves/étudiants et des enseignants, mais aussi leur engagement dans l'action individuelle et collective, ce que Beck a qualifié de 'sub-political engagement'.

L'enseignement des QSV contribue aux 'éducations à' : éducation à la citoyenneté (scientifique), éducation sexuelle, éducation pour la santé, éducation pour la sécurité, éducation à l'environnement et au développement durable. Les 'éducations à' mettent l'accent sur des questions complexes impliquant des incertitudes qui associent inextricablement des questions de nature scientifique et sociale ainsi que les valeurs et l'éthique.

Ce numéro comporte 9 articles, tous issus du deuxième symposium du Groupe de Recherche International sur Questions Socialement Vives (GRID QSV) ayant eu lieu les 8 et 9 juin 2015 à l´Institut d´Éducation de l´Université de Lisbonne (Portugal). C'est lors du premier symposium qui s'était déroulé à Toulouse, en 2014 (vérifier), qu'avaient été évoquées des questions ombilicales et récurrentes de Questions socialement vives (QSV) et une typologie des travaux sur les QSV en termes de didactisation avaient été ébauchée (voir Legardez, ce numéro). Les deux jours de conversation à Lisbonne ont permis de mener plus avant les réflexions et les conversations au sujet de modélisations pertinentes, de recherche et d'enseignement sur les QSV à déployer.

LES CONTRIBUTIONS

Les Questions Scientifiques Socialement Vives (QSSV) sont complexes et impliquent une pluralité de réponses possibles. Au sein de la classe, leur enseignement mène à identifier et à contextualiser des incertitudes technoscientifiques. Dans cet ordre d'idées, LUCAS NEDELEC, LAURENCE SIMONNEAUX et GREGOIRE MOLINATTI proposent une identification des objets d'incertitudes socio-épistémiques inhérents aux technosciences controversées en vue de mieux comprendre les risques ressentis par les enseignants liés à l'enseignement des QSSV.

RALPH LEVINSON suggère ensuite que les QSV soient envisagées sous leur angle politique. Il conseille d'une part, que les savoirs et l'alphabétisation politiques soient introduits dans l'enseignement et, d'autre part, que les QSV prennent en considération la nature politique des écoles en adoptant une posture critique à l'égard des influences néolibérales sur l'éducation.

LAURENCE SIMONNEAUX, JEAN SIMONNEAUX et NADIA CANCIAN éclairent la transition agroécologique vers un système plus durable. Ils montrent qu'elle est confrontée à un

verrouillage du régime socio-technique. Mobilisant le cadre de la théorie des transitions (Geels & Shot, 2007), les auteurs expliquent que l'enseignement des questions vives agro-environnementales pourrait contribuer à déverrouiller la transition agroécologique en mettant en exergue les aspects économiques, politiques ainsi que les risques et incertitudes liées à l'agriculture intensive.

AGNIESZKA JEZIORSKI s'intéresse à l'intégration des QSV dans la formation des enseignants en éducation au développement durable (EDD) critique. S'appuyant sur les résultats d'une douzaine d'entretiens individuels, elle présente des appuis et des obstacles à l'implémentation des questions socialement vives dans les systèmes éducatifs formels et identifie des leviers d'action pour la formation des enseignants.

ALAIN LEGARDEZ, nous convie quant à lui à revisiter des propositions faites dans la période d'émergence du domaine de recherches sur les QSV. Ce faisant, il poursuit son analyse de modélisations et de typologisation des travaux sur les QSV et contribue à éclairer les pratiques des acteurs de l'enseignement dans une perspective de transformation de la société.

NUNO ALBANO explore le potentiel éducatif de l'apprentissage des multimédias en matière de citoyenneté active. Articulant son propos à une étude qui met en scène l'apprentissage multimédia et la citoyenneté active, il souligne que l'engagement des jeunes peut améliorer leurs capacités techniques. Cette contribution, plus qu'une réflexion définitive, se présente comme une réflexion porteuse de multiples avenues.

Dans leur contribution, ANA RITA MARQUES et PEDRO REIS s'appuient sur une recherche menée auprès de 30 élèves de 13 et 14 ans sur les effets de la production et de l'utilisation de vodcasts sur leur sentiment d'être en mesure d'agir comme citoyen. Les auteurs pointent l'intérêt du thème de la pollution environnementale pour inviter les jeunes à se considérer comme des citoyens capables d'identifier des pistes d'action appropriées.

NATHALIE PANISSAL s'intéresse à l'enseignement des technosciences auprès d'élèves de 12 à 19 ans dans une perspective d'éducation citoyenne aux sciences. Elle mentionne avec pertinence que les nanotechnologies ont une action performative sur la société mais que leur développement suscite des inquiétudes quant à leurs usages. Pour ces raisons, l'angle d'entrée des QSV permet d'expérimenter des dispositifs qui invitent à l'engagement citoyen et au développement de la pensée éthique des élèves.

La question de la neutralité des enseignants fait surface lorsqu'il s'agit d'enseigner des savoirs incertains liés à des enjeux divers notamment éthiques et politiques. Dans cette perspective, EMMANUELLE BROSSAIS propose une réflexion épistémologique sur différentes manières d'étudier la subjectivité des enseignants dans l'enseignement des QSV. Ce faisant, l'auteure situe le contexte dans lequel son projet d'une didactique clinique des Questions Socialement Vives prend place.

Laurence Simonneaux
Chantal Pouliot

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ÉDUQUER DANS UN MONDE INCERTAIN : QUEL CADRE POUR COMPRENDRE COMMENT LES ENSEIGNANTS APPREHENDENT LES INCERTITUDES DES QUESTIONS SOCIALEMENT VIVES ?

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RESUME

Nous vivons à l'ère des incertitudes. Le développement des technosciences génère de grandes questions auxquelles les sociétés sont incapables de répondre avec certitude et universalité. Cet état d'indétermination généralisée entre en tension avec un traitement traditionnellement cartésien de l'imprévisibilité. Au débat épistémologique fondamental de la certitude des connaissances scientifiques s'agrègent désormais des incertitudes sociales, politiques, informationnelles, réflexives, etc., qui structurent les dynamiques des controverses dans l'espace social. Au sein de la classe, l'enseignement des questions socialement vives matérialise ces incertitudes, du fait de leur complexité et de la pluralité de réponses potentielles qu'elles impliquent. En France, leur introduction en classe crée un certain nombre de difficultés pour les enseignants: outre un ensemble de contraintes professionnelles et pédagogiques, l'appréhension des incertitudes semble en être un des principaux freins. Nous proposons donc ici, dans une approche théorique qui mobilise des regards issus de la sociologie des sciences, une identification des formes d'incertitudes socio-épistémiques inhérentes aux technosciences controversées. Dans le champ de la didactique des sciences, cette approche par les incertitudes permet de mieux comprendre les risques d'enseignement des questions socialement vives ressentis par les enseignants. Il s'agit alors, dans une optique d'autonomisation des enseignants telle que le développe le projet PARRISE, d'élaborer des processus de formation qui permettraient de mieux appréhender ces incertitudes, non pas en tentant de les réduire ou de les minimiser, mais en les identifiant et en les contextualisant.

MOTS-CLES

Question Socialement Vives, Controverses socio-scientifiques, Technosciences, Incertitudes, Formation des enseignants, Risques d'enseigner.

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EDUCATION IN AN UNCERTAIN WORLD: WHICH FRAME TO UNDERSTAND HOW THE TEACHERS GRASP THE UNCERTAINTIES OF THE SOCIALLY ACUTE QUESTIONS?

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ABSTRACT

We live in the age of uncertainties. The development of technosciences creates huge interrogations for which societies are unable to answer with certainty and universality. This general undetermined state collides with the Cartesian traditional treatment of the unpredictability. In addition to the fundamental epistemological debate about the certainty of scientific knowledge, appear by now some social, political, informational, reflexive (etc.) uncertainties that structure the dynamic of the controversies in the social space. Within classroom, the teaching of socially acute questions provides the opportunity to work these uncertainties, because of their complexity and the plurality of potential answers they include. In France, their introduction in classroom causes several difficulties to teachers: beside a set of professional and pedagogical constraints, the apprehension of uncertainties seems to be one of the major brakes. With a theoretical approach that mobilizes some points of view from sciences sociology, we propose here an identification of the forms of socio-epistemic uncertainties related to controversial technosciences. In the field of sciences didactic, this uncertainties approach allows a better comprehension of the socially acute questions' teaching risks felt by teachers. Toward a goal of teachers' empowerement as the PARRISE project aims, the issue is to elaborate a teacher professional development process that could help to grasp these uncertainties, not to reduce or minimize them, but rather to identify and contextualize them.

KEY WORDS

Socially Acute Questions, Socio-scientific issues, Technosciences, Uncertainties, Teachers trainning, Teching risks.

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EDUCAÇÃO NUM MUNDO INCERTO: QUE MOLDURA TEÓRICA PARA COMPREENDER COMO OS PROFESSORES ENQUADRAM AS INCERTEZAS DAS QUESTÕES SOCIALMENTE VIVAS?

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RESUMO

Vivemos na era das incertezas. O desenvolvimento das tecnociências cria grandes interrogações para as quais as sociedades são incapazes de responder com certeza e universalidade. Este estado geral indeterminado colide com o tratamento tradicional cartesiano da imprevisibilidade. Adicionalmente ao debate epistemológico fundamental sobre a certeza do conhecimento científico, aparecem algumas incertezas sociais, políticas, informacionais e reflexivas (etc.) que estruturam a dinâmica das controvérsias no espaço social. Dentro da sala de aula, o ensino das Questões Socialmente Vivas permite a oportunidade para trabalhar estas incertezas devido à sua complexidade e à pluralidade de respostas que estas incluem. Em França a sua introdução na sala de aula causa algumas dificuldades aos professores: para além do conjunto de constrangimentos profissionais e pedagógicos, a apreensão das incertezas parece ser um dos maiores obstáculos. Com uma abordagem teórica que mobiliza alguns pontos de vista da sociologia das ciências, propomos aqui a identificação das formas das incertezas socio-epistemológicas relacionadas com as controvérsias das tecnociências. No campo das ciências da didática, esta abordagem às incertezas permite uma melhor compreensão dos riscos associados ao ensino das Questões Socialmente Vivas sentidos pelos professores. Com o objetivo de promover a autonomia dos professores como é o do projeto PARRISE, a questão é elaborar um processo de desenvolvimento profissional dos professores que ajude a apreender estas incertezas, não para reduzi-las ou minimizá-las, mas antes para as identificar e contextualizar.

PALAVRAS-CHAVE

Questões Socialmente Vivas, Questões sociocientíficas, Tecnociências, Incertezas, Formação dos professores, Riscos do ensino.

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Éduquer Dans un Monde Incertain: Quel Cadre Pour Comprendre Comment les Enseignants Appréhendent les Incertitudes des Questions Socialement Vives?

Lucas Nedelec | Laurence Simonneaux | Grégoire Molinatti

LE TEMPS DES INCERTITUDES

À LA RACINE DES INCERTITUDES, UNE CRISE EPISTEMOLOGIQUE

Les situations de crises, de chocs, de mutations successives qui plongent les sociétés dans des états d'indétermination amènent certains penseurs à qualifier notre post-modernité comme l'ère des incertitudes (Funtowicz & Ravetz, 1993). Paradoxalement, le volume de savoirs produits et disponibles n'a jamais été aussi grand. L'innovation technologique présente un développement exponentiel et dénote les modes de production d'une technoscience globalisée. Comment expliquer ce paradoxe apparent entre une perception accrue de l'incertitude et une accélération de la production de savoirs ? La question prend tout d'abord racine dans une crise épistémologique. Les sciences, historiquement, ont toujours candidaté au rôle de premières productrices de certitudes. Le cogito de Descartes voyait l'exercice de la pensée scientifique comme un acte de sculpture où le doute tenait lieu de burin, pour réduire un bloc de matière brut – le réel ? - à un socle de certitudes. La philosophie positiviste ensuite, puis le positivisme logique, ont cherché à trier croyances et certitudes, au moyen d'une rigueur méthodologique censé attribuer à ces dernières un statut d'universalité. Mais un ensemble de nouveaux paradigmes, falsificationisme poppérien et normalité kuhnienne en tête, ont ouvert la brèche des relativismes, considérant dès lors que l'ensemble des savoirs scientifiques disponibles à un moment donné ne pouvaient guère prétendre au statut de vérités définitives. Plus précisément à propos de cette notion de certitude, attardons-nous sur l'apport de Bachelard. L'épistémologue considère que toute connaissance scientifique se base sur une forme d'approximation. Le cas des ordres de grandeur manipulés en sciences physiques l'illustre : censées représenter l'invisible, l'infiniment grand ou l'infiniment petit, les échelles mathématiques utilisées ne sont que des traductions de dimensions spatiales parfois inconsidérables par la cognition humaine, et ne peuvent revendiquer une exactitude certaine. Les mesures sont certes affinées au fur et à mesure de l'avancée des recherches mais ne pourront jamais prétendre au statut de précision absolue car définitive. C'est dans ce sens qu'il serait légitime de parler de connaissance approchée plutôt que de certitude scientifique (Bachelard, 1969). Ces considérations épistémologiques ont rejoint les interrogations philosophiques sur le statut de la connaissance pour provoquer ce que Morin appelle « la crise des fondements de la

connaissance » (Morin, 1986, p. 14). Cette crise a notamment fait émerger une dialectique de l'incertitude : plus la recherche scientifique instaure de nouvelles certitudes et plus l'étendue de notre inexpérience ne semble immense. Aujourd'hui, « comme nous vivons l'époque sans doute la plus exaltante pour le progrès de la connaissance, la fécondité des découvertes, l'élucidation des problèmes, nous nous rendons difficilement compte que nos gains inouïs de connaissance se paient en gains inouïs d'ignorance » (Morin, 1986, p. 13).

LES INCERTITUDES DES TECHNOSCIENCES

Le débat sur la nature des savoirs a traversé des siècles de recherche scientifique et philosophique. Si le statut de la certitude a été étudié sous de multiples aspects et regardé avec une grande pluralité de prismes, son contraire, l'incertitude, n'a été pensée qu'en négatif. Avec l'émergence des technosciences, cet angle mort commence toutefois à être considéré et notre travail vise notamment à participer à son exploration. Aux mises en doute épistémologiques se sont en effets adjoints de multiples questionnements éthiques, sociaux, économiques, etc., sur les conséquences de l'innovation. L'indétermination de la nature de la connaissance s'est ainsi élargie : l'altération du projet positiviste s'est doublée d'une remise en cause du bien fondé intrinsèque du progrès scientifique et technique. Ce phénomène dénote le redépassement d'une clôture entre les sciences et les sociétés, la production de savoir étant dès lors considérée comme une activité sociale à part entière et non une émanation d'une rationalité écrasant toutes les autres (Lévy-Leblond, 1996). Avec la forte demande sociale de réappropriation des avancées scientifiques qui est montée au cours du XXe siècle, « les scientifiques sont victimes de leur succès : ce qu'ils permettent de réaliser intéresse tout le monde » (Hottois, 2006, p. 29). La mise en débat des sciences dans l'espace social génère alors différentes formes de risque et d'incertitude – deux notions que nous distinguons d'ailleurs ultérieurement dans leur définition –, ou en tout cas les publicise, leur donnant une visibilité qui était jusque là confinée à la communauté scientifique. Les controverses socio-scientifiques catalysent ces incertitudes (Callon, Lascoumes & Barthe, 2001) et laissent apparaître une seconde brèche. En effet, si l'on est en droit de s'interroger sur les conséquences du progrès, quelle décision prendre alors au regard d'enjeux sociaux, économiques et environnementaux considérés comme prioritaires par rapport à l'impératif scientiste de l'innovation pour l'innovation ? Cette incertitude de la décision est d'autant plus vive que les processus de production technoscientifique s'accélèrent et se spécialisent. Ainsi « s'ajoutent toutes les incertitudes dues à la vélocité et à l'accélération des processus complexes et aléatoires de notre ère planétaire que ni l'esprit humain, ni un super-ordinateur, ni aucun démon de Laplace ne sauraient embrasser » (Morin, 2000). C'est en cela que les incertitudes technoscientifiques rejoignent l'incertitude épistémologique de la connaissance : au fur et à mesure que la prise en charge prétendument rationnelle des risques s'incarne via des dispositifs de calcul ou de délibération, la zone d'incertitude qui la jalonne s'agrandit proportionnellement, révélant au grand jour ce qui était encore sous-jacent lorsque les sciences seules avaient prétention à dire la vérité du monde.

Dans ce cadre, des voix se font entendre, appelant à des perspectives éducatives nouvelles qui permettraient aux citoyens de demain d'appréhender ces phénomènes et, surtout, d'être en capacité de les influencer. Morin (2000) considère notamment l'éducation à l'incertitude comme l'un des « 7 savoirs nécessaires à l'éducation du futur ». Dans cette optique, l'émergence des incertitudes est abordée comme une opportunité positive et non comme un effondrement : « les incertitudes sont des stimulants de l'attention, de la vigilance, de la curiosité, de l'inquiétude qui, à leur tour, stimulent de nouvelles stratégies cognitives » (Pena-Vega, 2014, p. 5). Sormany (1996) prône quant à lui un « partage de l'ignorance » comme colonne vertébrale de l'éducation scientifique. Considérer ces zones d'incertitudes dans le processus d'apprentissage, c'est aussi remettre l'éducation aux sciences en adhérence avec le monde social :

> C'à quoi les futurs citoyens auront affaire, ce par rapport à quoi les exigences de la démocratie imposent qu'ils deviennent partie prenante n'a rien à voir avec les légendes dorées de la science faite. Ce à quoi ils devraient devenir capables de s'intéresser, c'est à la science "telle qu'elle se fait", avec ses rapports de force, ses incertitudes, les contestations multiples que suscitent ses prétentions, les alliances entre intérêts et pouvoir qui l'orientent, les mises en hiérarchie des questions, disqualifiant les unes, privilégiant les autres. C'est à partir de tout cela que se construit leur monde. (Stengers, 1997, p. 113)

L'introduction des questions socialement vives en classe est une des réponses possibles à ces enjeux. Parce qu'elles sont ouvertes, instables dans le temps et dans l'espace (Sadler & Zeidler, 2005), parce qu'elles impliquent plusieurs groupes sociaux dont les rationalités et les systèmes de valeurs diffèrent (Levinson, 2006) et parce qu'elles appellent davantage qu'une unique solution scientifique, les questions socialement vives sont « porteuses d'incertitudes » (Simonneaux & Legardez, 2011, p. 19). Ici, notre proposition vise donc à articuler la contextualisation des incertitudes technoscientifiques avec la didactique des questions socialement vives, dans le but d'outiller spécifiquement les enseignants pour le développement d'une éducation à l'incertitude.

IDENTIFIER ET CONTEXTUALISER LES FORMES D'INCERTITUDES SOCIO-EPISTEMIQUES

DEFINITIONS

Une tentation courante est d'amalgamer incertitudes et risques. Ils sont pourtant de faux-amis : l'incertitude est un état d'indétermination plus ou moins radicale tandis que le risque est un danger potentiel identifiable. Le terme de risque trouverait son origine

dans l'italien risco, lui-même issu du mot latin resecum, littéralement "ce qui coupe" (Dir. Rey, 2012). Le risque inclut de ce fait la possibilité ou l'éventualité d'un danger, d'un dommage auquel le sujet est exposé. Nos sociétés ont mis en place des dispositifs pour permettre d'anticiper, de mesurer et de réparer les risques du développement des technosciences. La multiplication des outils de calcul, de modélisation à grande échelle, d'évaluation des probabilités que tel ou tel événement survienne en fonction de telle ou telle variable – les modélisations géo-climatiques du GIEC en sont un des exemples les plus probants – illustre cette tentative de prise en charge rationalisée des risques. Cette prise en charge, ce « gouvernement des risques » (Jas & Boudia, 2015, p. 381), rejoint l'objectif d'acceptabilité sociale du développement cumulatif des technosciences. Le terme d'incertitude quant à lui, dans sa définition étymologique, est lié à son versant positif : ce qui de relève de l'in-certaineté, du fait du préfixe négatif in, exprime donc le caractère de ce qui n'est pas indubitable (Dir. Rey, 2012). Alors, si les technosciences essayent d'internaliser les dangers potentiels de leur propre développement par des dispositifs de calcul et d'anticipation, elles n'ont pas pour autant annihiler les incertitudes qui les englobent. En effet, l'incertitude peut être mesurée encore moins précisément que le risque, car « on sait qu'on ne sait pas, mais c'est à peu près tout ce que l'on sait : il n'y a pas meilleure définition de l'incertitude » (Callon, Barthe & Lascoumes, 2001, p. 40).

DES FORMES D'INCERTITUDES SOCIO-EPISTEMIQUES

Notre proposition d'identification des formes d'incertitudes propres aux technosciences controversées croise trois regards en sociologie des sciences qui traitent explicitement de la notion d'incertitude (Beck, 2008 ; Callon, Barthe & Lascoumes, 2001 ; Chateauraynaud, 2008) auxquels s'ajoutent d'autres références qui la traitent de façon plus implicite (Bensaude-Vincent, 2003 ; Pestre, 2003). Plutôt qu'une typologie à visée exhaustive et normative, nous souhaitons ici proposer une identification ouverte et possible parmi d'autres de ces incertitudes que nous qualifions de socio-épistémiques.

Incertitude épistémique

Cette première forme d'incertitude est relative à la nature des sciences : comme nous l'exposions en convoquant Bachelard (1969), il porte sur l'incapacité des connaissances scientifiques à revendiquer le statut de certitude sur le monde. Cette forme d'incertitude a toujours été constitutive de la démarche scientifique et n'est pas caractéristique de la période post-moderne en tant que tel. C'est davantage sa visibilité et sa conscientisation collective qui sont réellement nouveaux. L'incertitude épistémique est mêlée à d'autres formes d'incertitudes, celles des données et des sources par exemple, et en constitue souvent un des éléments déclencheurs.

Incertitude des effets

Le déclin du projet scientiste implique que les sciences « ne sont (...) plus uniquement la source des solutions aux problèmes, mais aussi et en même temps la source des problèmes eux-mêmes » (Beck, 2001, p. 343). Chose nouvelle, à l'auto-critique exercée par des sciences sur elles-mêmes s'ajoute une critique des sociétés vers les sciences. Une innovation technique ou une avancée scientifique n'est plus perçue comme une chose juste ou utile en soi, elle est avant tout soumise à l'exercice critique, à une inspection sociale réflexive, et véhicule une incertitude relative à ses potentiels effets futurs. La distinction entre incertitude et risque est ici à rappeler : dans le cas du nucléaire par exemple, les scientifiques sont capables de calculer le risque d'accident dans un réacteur en cas de séisme, de température élevée ou d'inondation et de dégager les conditions plus ou moins précises dans lesquelles ce danger potentiel pourrait advenir. Mais aucun calcul ne peut réellement identifier les effets sanitaires d'une explosion ou d'une fuite majeur d'un de ces réacteurs, ni leur coût économique. Les projections nécessaires au calcul de cette potentialité sont en effet trop incertaines pour être réellement soupesées. Nous nous situons donc bien dans ce cas dans le champ d'un état d'indétermination globale que nous pouvons qualifier d'incertitude.

Incertitude des décisions

Chateauraynaud convoque Lefort pour questionner la place de l'incertitude dans le système politique : « Tant que l'aventure démocratique se poursuit […], le sens de ce qui advient demeure en suspens. La démocratie se révèle ainsi la société historique par excellence, société qui dans sa forme accueille et préserve l'indétermination, en contraste remarquable avec le totalitarisme qui, s'édifiant sous le sigle de la création d'un homme nouveau, s'agence en réalité contre cette indétermination, prétend détenir la loi de son organisation et de son développement » (Lefort, 1986, cited in Chateauraynaud, 2008, p. 13). La forme d'incertitude que nous appelons ici l'incertitude des décisions intervient en effet sur le plan politique. La volonté de réappropriation sociale du progrès scientifique et les modalités de cette réappropriation ouvrent de vastes espaces de débats. A l'instar des forums hybrides théorisés par Callon, Lascoumes et Barthe (2001) et d'autres dispositifs effectifs telles que les conférences de citoyen mises en œuvre à la fin des années 1990 en France autour de la controverse des Organismes Génétiquement Modifiés, divers modes de délibération ont été proposés pour mettre le futur des sciences en débat. S'il existe donc une incertitude sur les formes de décision qui peuvent répondre aux attentes sociales, le questionnement porte également sur les champs d'action et les valeurs qui sous-tendent ces décisions. Beck situe deux perspectives pour orienter les décisions : l'une est de supprimer les causes elles-mêmes des risques engendrés par les mutations technoscientifiques, l'autre est de prendre en charge les symptômes et les conséquences des mutations. Pour le sociologue, la seconde piste était jusqu'alors privilégiée, à tort, parce qu'elle permettrait notamment d'occulter la première sans régler fondamentalement le problème. Si nous réutilisons l'exemple de

l'énergie nucléaire, la première option serait dans ce cas de trouver une alternative à cette forme de production énergétique afin de pouvoir s'en passer et de supprimer ainsi les risques engendrés. La seconde option serait plutôt de mesurer ces risques et d'en traiter les symptômes, ce qui est l'option poursuivie en France actuellement : enfouissement géologique profond des déchets nucléaires à haut niveau de radioactivité ou à durée de vie longue, innovations technologiques pour mieux protéger les réacteurs, procédures d'alertes pour prendre en charge les conséquences sanitaires d'un accident potentiel, etc. L'incertitude des décisions porte donc à la fois sur ses modalités, mais aussi ses champs d'influence et ses légitimités. Comment apporter le plus démocratiquement possible une réponse à une controverse socio-scientifique ? Avec quel processus d'interaction et de décision ? A propos de quels champs d'action ? Et surtout, en fonction quelles valeurs et finalités sociales peut-on alors les légitimer ?

Incertitude des données et des sources

Le processus de production des connaissances scientifiques est marqué par une double évolution : les connaissances et les données sur lesquelles elles s'appuient se complexifient et se spécialisent progressivement. Dans le contexte de la société du risque, le doute épistémologique propre à la nature des sciences s'est élargi à la société toute entière : « Les argumentations scientifiques […] semblent avoir perdu en se généralisant l'aura d'autorité rationnellement inattaquable, et devenir socialement disponibles. […] Que les assertions scientifiques ne soient plus sacrosaintes mais puissent être contestées dans la vie de tous les jours ne signifie rien d'autre que le fait que le doute systématique, privilège structurel du discours scientifique, n'est plus l'apanage de la science » (Bonß & Hartman, 1985, cited in Beck, 2008, p. 369). A travers les catalyseuses d'incertitudes que sont les controverses, la multiplication des contre-expertises illustre cette tendance. Au sein de la controverse du nucléaire, des données contradictoires à propos du même objet co-existent et sont produites par des sources en situation de concurrence, scientifiquement parlant. La Commission de recherche et d'information indépendantes sur la radioactivité (CRIIRAD) ainsi que des Organisation Non-Gouvernementales comme Greenpeace publient régulièrement des résultats visant à contredire les analyses des instances institutionnelles telles que l'Autorité de sûreté nucléaire (ASN) ou l'entreprise Électricité de France (EDF). Dans les débats se tenant au sein de l'espace public français à propos du nucléaire, les discussions voient ainsi s'affronter des arguments de fond, des systèmes de valeurs, des postures politiques, mais aussi des auto-attributions de légitimité scientifique quant aux données utilisées. Si cette incertitude tient en partie du fait de la démystification de la parole scientifique, elle doit aussi quelque chose à la révélation des conflits d'intérêts existants entre certaines parties prenantes : les entreprises multinationales mènent des actions de lobbying pour faire produire des données scientifiques sous le masque de la neutralité méthodologique ; certains journalistes ou experts entretiennent des liens étroits avec des acteurs scientifiques sans les expliciter auprès de leurs interlocuteurs ; des responsables politiques prennent position dans des controverses en utilisant des arguments dont la source partage avec eux un certain intérêt ; etc. Dans ces situations où les réseaux

d'arguments sont complexes, il existe donc une forte incertitude portant sur le contexte dans lesquelles les sources et les données sont produites et utilisées, selon des orientations politiques plus ou moins transparentes.

Incertitude des acteurs

Le premier aspect de cette forme d'incertitude porte sur l'émergence de nouveaux acteurs dans le débat socio-scientifique. La controverse est un « mode d'exploration » (Callon, Lascoumes & Barthe, 2001, p. 50) de l'espace social et met au jour les « débordements » de l'évolution des technosciences. Des parties prenantes qui n'étaient jusqu'alors pas considérées comme des interlocuteurs légitimes par les scientifiques et les politiques font leur apparition : riverains, associations de consommateurs, contre-experts, collectifs informels et éphémères créés autour d'un intérêt commun, s'invitent dans les échanges et mettent en place leur propre balistique argumentative (Chateauraynaud, 2011). Les débats de rationalité qui en résultent soulèvent un second aspect, celui de la responsabilité de ses acteurs. Qui est responsable d'une conséquence imprévue ? D'un danger identifié sous la forme d'un risque mais sous-estimé jusqu'alors ? Réutilisons l'exemple du nucléaire : dans l'explosion de deux réacteurs de la centrale nucléaire de Fukushima-Daiichi en 2011, quel acteur peut être considéré comme responsable et dans quelle mesure ? Est-ce l'opérateur Tepco qui n'a pas assez renforcé les infrastructures de sa centrale au vu des risques naturels qui pesaient sur le site ? Est-ce l'État japonais critiqué pour sa gestion de crise une fois la catastrophe survenue ? Sont-ce les services de surveillance sismique qui n'ont pas pu anticiper l'ampleur du tsunami qui a endommagé la centrale ? Nous pourrions prolonger ces interrogations – et ces débats ont d'ailleurs largement traversé la société japonaise suite à la catastrophe – et en discuter longuement sans forcément pouvoir y répondre avec certitude. Il est d'ailleurs impossible d'anticiper ces questions tant elles semblaient initialement improbables, quand la probabilité d'un tel accident n'était qu'un chiffre minoré parmi un ensemble de risques : nous sommes bien là dans le registre d'une indétermination générale. En outre, le débordement social et politique provoqué par les controverses reconfigure le rapport à l'expertise et à la prise de décision : « les sciences se trouvent ainsi de moins en moins en mesure de satisfaire à l'exigence de certitude des commanditaires soumis à la pression de la décision. Avec la généralisation du faillibilisme, la science transfère ses doutes du côté des utilisateurs et les contraint ainsi à assumer de surcroît la réduction de l'incertitude nécessaire à l'action » (Beck, 2001, p. 384). Si effectivement les politiques en responsabilité opèrent une dévolution du sens de la production scientifique, notamment en mobilisant différentes formes d'expertise, les acteurs sociaux, qu'ils soient citoyens, politiques, contre-experts, etc, investissent eux-mêmes l'espace resté vaquant et les incertitudes qui l'englobent. Les conflits de valeurs qui en résultent créent par conséquent de l'incertitude. Ainsi, « in discussing contemporary controversial issues, then, we are often dealing with concepts that are contentious, indeterminate, and unstable – democracy, citizen, gene, disease, (controversy) – and therefore using contemporary critical standards of verification is, at the very least, problematic » (Levinson, 2006, p. 1206). L'intervention d'un acteur dans

une controverse sous-tend ainsi des motivations et des justifications en terme de valeurs, d'intérêts et de légitimités qui ne peuvent pas être précisément déterminés à l'avance. Notons que cette dimension est également reliée à l'incertitude des données et des sources : la place qu'occupe un acteur dans une controverse est en partie provoquée par les types d'arguments mis en jeu, ou, en rétroaction, influence les types d'arguments qui seront mobilisés.

Incertitude (réflexive) de l'incertitude

Nous l'avons dit, la question de la responsabilité des sciences n'appartient plus aux scientifiques, elle appartient aux communautés socio-politiques concernées. Dans les critiques qui s'exercent, quelles que soit leur nature, interviennent à la fois des arguments épistémologiques comme des arguments moraux, économiques, politiques, etc. Sur quels contours doit s'exercer la mise en culture des sciences (Lévy-Leblond, 1996), ou ici sa mise en critique ? Quelle critique des technosciences est légitime et laquelle ne l'est pas, au regard de quels critères ? Dans cette incertitude réflexive se cache aussi une incertitude ontologique : « cet état transitoire nous oblige à vivre en sachant que cette incertitude est maintenant un élément essentiel de nos vies. Mais, tout de même, n'a-t-elle pas toujours fait partie de l'expérience humaine ? » (Montuori & Khalifa, 2014, p. 179) De surcroît, notre modeste proposition d'identification de ces formes d'indétermination se heurte elle-même à ses limites épistémologiques. D'autres formes n'ont peut-être pas été identifiées, car notre subjectivité intrinsèque, l'évolution dynamique des régimes des technosciences ou notre parti pris théorique nous en auraient empêchés. Tout comme le programme fort de l'École d'Édimbourg s'appliquait à lui-même le principe de symétrie (Bloor, 1982) et reconnaissait que la pertinence scientifique de sa théorie était soumise à des déterminations socio-culturelles, je suis bien obligé de reconnaître qu'il existe aussi une incertitude des incertitudes.

DES ENSEIGNANTS DEMUNIS FACE AUX INCERTITUDES DES TECHNOSCIENCES

LES DIFFICULTES D'UN BASCULEMENT

L'introduction des questions socialement vives à l'école matérialise ces différentes formes d'incertitude au sein de l'espace scolaire. Le basculement proposé par ce type d'enseignement réside dans le rapport à l'acquis, et en filigrane à la certitude scientifique : quand l'enseignement cartésien classique vise à mobiliser un ensemble de savoirs déjà établis et présentés comme certains, l'enseignement des questions socialement vives invite au contraire à explorer des questions ouvertes qui ne se satisfont pas d'une réponse fondée sur une unique légitimation épistémologique. Alors, si « un pacte

d'instruction mobilisateur ne se bâtit pas sur une liste a priori de savoirs (ou plus généralement, d'œuvres), mais sur une liste de questions » (Chevallard, 1997, p. 5), c'est toute la représentation de la nature des sciences dans le processus d'apprentissage qui s'en trouve modifiée. Là se situe un nœud majeur de l'évolution de l'éducation aux sciences. Dans l'enseignement des questions socialement vives, la prééminence de toutes ces incertitudes pose problème et se confronte à une forte inertie dans le rapport à la certitude scientifique. Albe et Simonneaux (2002, p. 149) relèvent ainsi l'appréhension négative ressentie lorsqu'il s'agit effectivement d'introduire ces questions ouvertes en classe : « enseigner des sciences c'est enseigner des faits, des certitudes, [les questions socialement vives] impliquent de s'aventurer sur des registres pour lesquels [les enseignants] ne se sentent aucune légitimité ». Dans un contexte anglo-saxon, Levinson (2004) souligne par ailleurs que les enseignants des sciences expérimentales s'appuient grandement sur les savoirs établis et laissent une visibilité très faible aux incertitudes dans la manière dont ils travaillent les sciences avec leurs élèves, ce qui serait moins le cas chez les enseignants de sciences sociales. De surcroît, Simonneaux et Simonneaux (2006) notent une ambivalence apparente chez les enseignants de sciences des filières agricoles. Une grande majorité de l'échantillon d'enseignants qu'ils ont interrogé considère à la fois que la recherche scientifique est créatrice de vérités potentielles et de bénéfices pour la société, tout en reconnaissant que cette même recherche crée des risques et des incertitudes. En somme, les représentations enseignantes font co-exister une intentionnalité d'enseignement des incertitudes inhérentes aux technosciences avec un attachement très fort à la prétendue certitude des savoirs scientifiques établis, ce qui constitue une certaine injonction paradoxale. Peut-on expliquer cette ambivalence par un besoin psychologique de sécurité cognitive nous amenant à une forme d'« addiction aux certitudes » (Favre, 2013) ? Ou par une tradition cartésienne qui, dans les cursus français d'enseignement scientifique notamment, présente essentiellement des savoirs sédimentés révélateurs de la conception d'une science-vérité (Albe, 2009) ? Quoi qu'il en soit, à partir de ce constat, la didactique des questions socialement vives représente pour nous une porte d'entrée particulièrement utile pour comprendre la manière dont ces formes d'incertitudes sont appréhendées par les enseignants.

INCERTITUDES ET RISQUES D'ENSEIGNER LES QUESTIONS SOCIALEMENT VIVES : UN ENJEU CRUCIAL DE LA FORMATION DES ENSEIGNANTS DE SCIENCES

Nous l'avons vu, enseigner des questions vives empruntes d'incertitudes n'est pas sans provoquer un certain nombre de difficultés, qui se présentent comme autant de risques (Legardez & Simonneaux, 2006). Risque normatif ou au contraire risque nihiliste, risque de réchauffement ou de refroidissement de la question, risque de neutralisation des incertitudes constituent les écueils possibles de la mise en œuvre d'une éducation à l'incertitude qui n'aurait pas intégré la nécessité d'adapter les stratégies didactiques à la nature des questions enseignées. De ce point de vue, l'enjeu de la formation des

enseignants se révèle crucial en didactique des questions socialement vives : « les enseignants scientifiques se retrouvent sollicités sur les faits et les incertitudes des savoirs impliqués et interpellés sur les répercussions de ces savoirs. Ceci impose de mettre l'accent sur la formation socio-épistémologique des enseignants en sciences » (Albe & Simonneaux, 2002, p. 150). Cet enjeu concerne également d'autres approches en sciences de l'éducation – inquiry based-learning et citizenship education notamment - qui cherchent à faire converger leurs modèles, notamment au sein du projet PARRISE, pour proposer des pratiques de formation des enseignants mieux adaptées à la nature des technosciences et aux attentes sociales, avec une finalité d'empowerment (Levinson et al., 2014). Mais avant de penser la manière de former les enseignants à cette adaptation, il nous a semblé essentiel de proposer un cadre théorique souple mais structurant de compréhension des formes d'incertitudes en jeu dans les controverse socio-scientifiques et les technosciences en général. Il s'agira ensuite d'interroger plus finement la façon dont les enseignants de sciences appréhendent ces incertitudes, c'est-à-dire comment ils les vivent et les expriment, à partir d'une recherche empirique et d'une question vive spécifique qui nous servirait de support. Ce travail de compréhension vise finalement à poser un jalon parmi d'autres d'une formation à l'enseignement des sciences prenant place dans un monde incertain, pour des professionnels de l'éducation ayant bien davantage besoin d'outils d'exploration et d'enquête que de contenus prêt-à-enseigner.

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SAQs as a Socio-Political Programme: Some Challenges and Opportunities

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ABSTRACT

In this article I argue for the role that approaches such as Socially Acute Questions (SAQs) can play in confronting the STEM discourse in the curriculum. For SAQs and similar approaches to be effective in enacting issues of social justice educators need to take account of local political contexts, the ethical and political assumptions which underpin values appertaining to social justice, such as concepts of communalism and libertarianism, and democratic practise in the school classroom where the students become co-enquirers in generating knowledge which aims to improve material realities. This is not a straightforward but one that demands reflection and critique throughout the process.

KEY WORDS

Socially Acute Questions (SAQs), STEM, Science curriculum, Neoliberalism, Democracy, Action.

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QUESTÕES SOCIALMENTE VIVAS (QSV) COMO PROGRAMA SOCIOPOLÍTICO: ALGUNS DESAFIOS E OPORTUNIDADES

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RESUMO

Neste artigo discuto o papel que abordagens como as Questões Socialmente Vivas (QSVS) podem desempenhar quando confrontadas com os discursos sobre as STEM no currículo. Para que as QSV e outras abordagens similares sejam eficazes na adoção de questões de justiça social, os educadores precisam ter em conta os contextos políticos locais, os pressupostos éticos e políticos que sustentam os valores concernentes à justiça social, tais como conceitos de comunalismo e liberalismo e a prática democrática na sala de aula onde os alunos se tornam co-pesquisadores na produção de conhecimento com o objetivo de melhorar as realidades materiais. Não de uma forma automática, mas que exige reflexão e crítica ao longo do processo.

PALAVRAS-CHAVE

Questões Socialmente Vivas (QSV), STEM, Curriculum de ciências, Neoliberalismo, Democracia, Ação.

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SAQS as a Socio-Political Programme: Some Challenges and Opportunities

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INTRODUCTION

The discourse associated with socially acute questions (SAQs) or QSV has become more prominent in recent years as it has sought a distinctive but overlapping space in science–society education together with STS (Aikenhead, 1986), STS(E) (Pedretti & Nazir, 2011), SSI (Sadler, 2011), STEPWISE (Bencze et al., 2005) and Science as *praxis* (Roth & Lee, 2002). Where SAQs are distinctive is threefold: the omission of 'science' from the descriptor stressing multi- and inter-disciplinary approaches, hence a commonality with Fourez's (1997) concept of 'islands of rationality'; an emphasis on 'acute' questions, i.e. those that are controversial and socially urgent; and a socio-epistemic approach incorporating post-normal complexity, uncertainty and risk (Ravetz & Funtowicz, 1999). These generate pedagogic and school curricular implications to a greater extent than other science-society formulations because aspects such as complexity, risk and inter-disciplinarity receive greater emphasis. The loss of science also shifts thinking away from the application of disciplinary content to a social controversy, in curricular terms. However, as I indicate later, these possibilities for curriculum and pedagogy will vary and face different challenges depending on the regional and national contexts, and their socio-cultural and educational histories. SAQs reflect many of the realities encountered through technoscientific developments. Table 1 attempts to compare the different emphases of science-society approaches although I omit STS since its scope is too broad, and goes well beyond schools into the academe. Although Zeidler et al. (2005) have endeavoured to chart the characteristics of SSI, as they are in fact operationalised they incorporate a whole range of approaches from those that use it as a context to teach substantive science concepts to framing them within a critical thinking context. However, a common approach in SSIs is the development of moral character and reasoning. At any rate SSIs are deemed to have a less problematic epistemic relationship with national and regional curricula than the others.

Those advocating science-society approaches within school curricula face political, economic and educational challenges in the face of STEM, (Science, Technology, Engineering, Mathematics), an acronym that has crept up on the world of science education stealthily and with sudden rapidity, accompanied by terms such as 'innovation', 'competitiveness', 'entrepreneurship', 'enterprise' and 'excellence' (The Royal Society, 2009), all of which are prominent within neoliberal educational discourse, and point to a move in science and technology education to liaise more closely with business and private enterprise than with the public and state sectors. Hence, STEM has a social aspect – quite different in nature from that of SAQs. It makes particular claims for human capital to support technological innovation, and is itself a science-society

formulation, hence its inclusion in Table 1. Implicit, too, in the term STEM is inter-disciplinarity. US schools and UK schools need to emphasize a STEM epistemology to justify its social and economic existence and the ways in which science can support technology and engineering (Gough, 2015), although little work on pedagogic and curricular integration has been done in this direction. But the motivations of STEM are economic and corporatist. They are also political because the question arises as to whose benefits such changes are directed (Owen et al., 2009).

Table 1
Characteristics of science-society education approaches

Feature/ Approach	**STEM**	**SSI**	**SAQ**	**STEPWISE**	**SaP**
Full name	Science, Technology, Engineering and Mathematics	Socio-Scientific Issues	Socially Acute Questions (Questiones Socialement Vives)	Science & Technology Education Promoting Wellbeing for Individuals, Societies & Environments	Science as Praxis
Educational purpose	Provision of human capital as high-end resource for national and corporate economic competitiveness.	Development of scientific knowledge and 'socio-scientific reasoning'. Emphasis on moral development.	Critical discourse	Knowledge for action promoting wellbeing, social justice and sustainability.	Collaborative action for social justice
Role of school curriculum and epistemology	Generation of substantive core science concepts with an emphasis on integration.	Scientific knowledge and ethical positioning as basis for social context.	Interdisciplinary and humanistic	Draws on science laws and theories as one component including skills and research.	Both within and beyond boundaries of school and classroom. Emergent knowledge through action.
Socio-political action	No	No	Implicit	Explicit	Explicit

And that is one of the challenges for SAQs because the underpinning drive in science education in STEM, is one which sees schools and education as sources of human capital for economic growth through increased consumption. That is a controversial issue. The problem is that the science–society link becomes one which is appropriated into a broader STEM discourse. Extracts from the foreword to The Royal Society's report 'Hidden wealth' exemplify this:

> How has science contributed to this growth of wealth and enhanced quality of life via services? . . .
>
> . . . we set out to answer a simple question: where has science—in the widest sense—already contributed well to fostering innovation in the services sector and where and how might new policies enhance the situation? . . .
>
> We anticipate services delivered much more cheaply, to better quality and personalised to millions of individuals where that is desired. While much of this will be provided by the private sector, government can enhance its own services hugely by cloning the best of private sector developments to maximise value for taxpayers' money and to strengthen democracy. . .
>
> Ever better collaboration between STEM practitioners and social scientists and those in the humanities will be essential if the services are to be acceptable and fit for purpose. Changes in our educational system would also make a material contribution to such success. (The Royal Society, 2009, v)

There is little political analysis within school education circles of the effect of STEM; the rapidity of its advance is testament to that. What I argue is missing from an SAQ approach, and indeed other similar processes, is a more prominent political analysis. The epistemological basis of SAQs makes it possibly a more fruitful means of political challenge. But what does a political challenge then incorporate?

In this article I shall first discuss the political and ethical challenges to SAQs and for socio-scientific approaches more broadly, the implications for schools, curricula and pedagogy together with some operational questions which confront us.

POLITICAL AND ETHICAL CHALLENGES

My core argument for the incorporation of political literacy[1] and action[2] in science-society approaches is that the lack of these components results in trivial outcomes as a sort of faux mimicry of consideration of socio-scientific issues, and an acquiescence to the status quo. The intellectual roots of such a critique lie in Critical Theory (McCarthy, 1978) which warned that the power of science through prediction and control resulting from The Enlightenment project was enmeshed in a set of political and economic practices which was as likely to make technoscience an instrument of domination as of

1 Political literacy, sometimes called citizenship in different national curricula. Citizenship can, of course, become an excuse for nationalism, for example, as seen in recent publicity about the Japanese curriculum (www.bbc.co.uk/programmes/b04md589) but the acknowledgement of political knowledge in a critical context, is I would claim, an important one.

2 Later, I present a particular notion of action, something quite distinct from activity or making.

emancipation. It is the explicit realisation of this problematic: the duality of liberation and oppression which need to be confronted in science-society programmes.

Many critical scholars (Dewey, 1916; Giroux, 1988; Greene, 1986; Simon, 1992) have addressed the question of the roles of schools in democratic societies. All of these writers stress principles of social justice, compassion, acknowledgements of diversity and difference, collaboration, and criticality. All have critiqued extant curricula and stressed the education of critical citizenry challenging a predominantly capitalist, and nowadays, corporatist and neoliberal environment which is predominantly enslaving[3]. There have also been alternative discourses, some critical of critical pedagogy, which have highlighted their omission of feminist (e.g. Ellsworth, 1989), environmentalist and post-colonial thinking which have stressed sustainability, equality, oppression and have been critical of Enlightenment and rationalist approaches which have failed to counter socially oppressive assumptions and institutions.

So science education, and its broader component of scientific literacy, operates in a politically complex environment. It is important to stress 'complexity' because the emphasis on neoliberalism and its manifestation in school policy and management can sometimes obscure other social, pedagogic and historical trends which still retain influence. These will be different according to national and regional context. In the U.K., for example, the historical fingerprints in science education are influenced by:

a. The 1944 Education act which opened up secondary education to women and working class children, comprehensivisation of schools in the 1960s, 16+ examinations for all and Science for All in the 1980s and the contemporary moves to 'free' schooling from local authority control in a mixture of state and privately controlled sectors.
b. The influence of science for the worker since the industrial revolution (Layton, 1973), the establishment of vocational science and separation from academic science (quite different, for example, from the situation in Germany), the petitioning from a socialist—and scientistic—perspective of the importance of science for working people in the 1930s (e.g. Hogben, 1959), and the science-society movement in schools which had its political impetus to try and regain public confidence in science after disasters such as the salmonella outbreak, BSE, Chernobyl (House of Lords, 2000).
c. The importance of a liberal education in the UK which has its roots in elite 'public' (i.e. independent) schools, stresses the pre-eminence of domain-specific knowledge, i.e. school subjects (Hirst & Peters, 1970), and maintains the 'gold standard' of academic qualifications in tightly-bounded subjects (Bernstein, 1973) such as physics and mathematics.

The point to stress here is that although the countervailing trends of STEM and science-society approaches in schools appear on the surface similar throughout the post-industrial world there are important local and historical differences which constrain what

3 A current manifestation can be seen in the TTIP agreement (The Transatlantic Trade and Investment Partnership), aimed at reducing regulatory barriers on food safety, environmental laws, health warnings for large corporations. For example, the Uruguayan state is defending itself against a legal action from Philip Morris, a tobacco company, for increasing the size of health warnings on cigarette packets (www.independent.co.uk/news/business/analysis-and-features/big-tobacco-puts-countries-on-trial-as-concerns-over-ttip-deals-mount-9807478.html#).

is possible, and the perspectives through which teachers, school policy makers and students come to these issues. In that sense my own perspective is from the context of experience of teaching in London schools and teacher education in England, hence the political, professional and historic lens through which I view SAQs. (The multi-disciplinary component of SAQs, for example, might pose greater structural and pedagogic challenges in U.K. schools, than in French schools).

The Relevance of Science Education (ROSE) study (Sjoberg & Schreiner, 2005) is an important signifier in terms of what is possible in national contexts because it shows a tension in rich countries between interest in science as a career, achievement in science and student identity. Japan, which regularly achieves enviable scores in PISA and is a source of emulation for countries like the U.S. and the U.K., comes right at the bottom of the ROSE survey for student interest in science as a career.

POLITICAL EDUCATION

While there has been a profusion of policy statements and curriculum developments which have as their base science and society and the scientific citizen (NRC, 1996), and profound socio-political critiques of these reforms (e.g. Bencze & Carter, 2011), these still do not provide a vision of the social and political nature such reforms, and their critiques, aspire to. (Incidentally by a vision, I do not mean a 'blueprint', that would be calamitous and regressive). Contemporary critiques are directed towards how science and technology buttress the more nefarious effects of globalisation and/or the consumerist-driven aspects of neoliberalism. Others critique the governance of science and its collaboration with a repressive world order. From a very different perspective yet others have questioned the epistemological justification for any conjuncture between science as a discipline and social science (Donnelly, 2004), particularly its relationship to social action (Hadzigeorgiou, 2015).

So, what is the problem when policy statements about the science curriculum and scientific literacy highlight reflection and informed decision-making? The relationship between informed decision-making at a political level and school science knowledge is at best notional and untested, and at worst misconceived (Ryder, 2001). A high level of school knowledge of science is not a prerequisite for effective decision-making, and if there is a relationship it is likely to be highly complex (Dawson, 2000). What is missing is how any enactment of curriculum reforms and their associated pedagogical strategies which instantiate social justice as their core commitment, reflect the political nature of a society that might be deemed desirable. Both policy reforms (usually in terms of democratic participation and national competitiveness) and their critiques (usually attacks on the instrumentalist and consumerist positions of the reforms) identify extant problems: what they fail to do is first to map out what social and political changes are necessary to encompass desirable actions to achieve social justice through science education, and more strikingly how such reforms might be achieved, hence the necessity of action.

School curricula in many countries now incorporate citizenship or political literacy either as a subject in its own right or in a cross-curricular way. Although there are

differences of emphases between national ideas of citizenship education the main purposes are to enhance civic virtues towards the rights and responsibilities that are entailed by democratic participation. I think here this is a common concern of SAQs which recognises at source the influence of the products of science and technology on all our lives, and my point is that the political and action implications need greater emphasis and theorisation.

Contemporary views of social justice and the good society are frequently polarised between two foundational and incommensurate values: fairness in terms of equality (broadly egalitarianism) and freedom (broadly libertarianism). These portrayals are usually seen as a left-right divide respectively. Social justice for the left is a preference for the fair distribution of goods and necessities of life—access to health, food, education, and leisure—while for the right it is seen in terms of personal freedom ameliorated by some regulation to avoid poverty traps (Kymlicka, 2002). Ensuring fair distribution will necessarily affect personal freedom through strong regulatory measures to soften the effects of polarisation of wealth such as differential taxation schemes, while those in support of personal freedom will view state regulation as an unnecessary impediment to entrepreneurship and enterprise. An example of a socio-scientific issue which brings out these tensions is that of genetics where embryos can be genetically selected through ivf technology for certain features deemed desirable by prospective parents. A radical libertarian approach would be consistent with the technology that responds to market demands. This could portend a future where the wealthy have genetically selected children with so-called desirable characteristics which is not available to most people because of cost. There are, of course, deep ethical issues contingent with this technology. An egalitarian position would be consistent with an approach that has the technology available to all or to none. Making the technology available to all would, of course, put huge demands on the public health sector and a rational outcome could be that the technology is not made available to anyone, except in particular circumstances where life and/or health might be at risk. Note that expropriation of eggs from Third World countries (www.eggsploitation.com) is not excluded by either an egalitarian or libertarian approach although it possibly could be by the former when viewing egalitarianism in a more global context.

Freedom and equality are not the only foundational values in contemporary society—these include the common good (communitarianism), rights (libertarianism), identity (identity politics and multiculturalism), feminism, and so forth. Dworkin (cited in Kymlicka, 2002) argues that all plausible political theories must be egalitarian at base, i.e. treat and respect people as equals. So the fundamental argument is both moral and political—not whether people are equal but how to interpret equality and respect for human rights through social institutions such as technoscience. There seems to me to be a case to foreground this problematic as an interpretative framework for approaching technoscientific issues. School student activism therefore needs to:

i. Engage critically with the political knowledge and skills in any democratic process (for example, an explicit understanding of the potential conflicts between individual rights and distributive justice);
ii. Recognise the possibilities and limits of political action (conflicts between different interest groups; an understanding that moral outrage drives action which requires a rational understanding of conflicts of interest (Levinson, 2010).

So, there is not just the case of incorporating a political literacy component (knowledge of political systems and political morality) but there is the question of turning politically-informed desires into action.

THE ROLE OF ACTION

One of the problems, I think, which paralyses the possibilities of action in relation to knowledge is the dominance of the SSI paradigm in education that action presupposes conceptual knowledge (see Table 1). Historically this has its roots in Platonic thought and the separation between *episteme* (knowledge) (which arises from the contemplative, and hence privileged, life) and *techne*, i.e. doing (Dunne, 1993).

The rationale behind modern theories of *praxis*, derived from both Hegel and Marx, is the realisation of consciousness through action, which is a human engagement

> embedded within a tradition of communally shared understandings and values, that remain vitally connected to peoples' life-experience, that finds expression in their ordinary linguistic usage, and that, rather than being a means through which they achieve outcomes separate from themselves, is a kind of enactment through which they constitute themselves as persons in a historical community. It is through *praxis* that a person comes to have an individual identity, but at the same time it always transpires within an intersubjective medium. . . The moral subject, the subject of *praxis*, is inconceivable in abstraction from communicative relations with others. (McCarthy, 1978, p. 35)

So the relationship between knowledge and action is turned the other way around, that is, in a Deweyan sense, knowledge is accrued through collaborative inquiry in acting upon the world (Tobin, 2014). Action becomes an existential choice which becomes more challenging in a world saturated with discourses promoting a uniformity of consumption. There are aspects of action through *praxis* which cohere well with SAQ philosophy: the importance of language through collaborative discourse (although I see no good reason for any hierarchical analysis of these discourses) and the prominence in the urgency of SAQs of living in a late modern uncertain world (Giddens, 1990).

Action, as opposed to *techne* (Arendt, 1998) has no predetermined outcome. Because action involves participation and communication of diverse groups to change the world it must presuppose trust and openness. Knowledge grows through thought and action but is reflexive because the progress of action is always uncertain and leads to new sources of knowledge. However, unless political knowledge and *nous* underpin action the outcomes will be technical fixes, increased control or individualisation. Two examples illustrate my point.

The first derives from a research informed approach on assessment, particularly influential in school science education in the U.K., which was designed to make assessment more transparent to the learner and to open up a dialogue between peers

and students and students and teachers to negotiate and inform learning (Black et al., 2003). Assessment was seen as a 'black box' which needed to be opened and reconfigured. The result of this research into Assessment for Learning. AfL, was disseminated as good practise in which dialogue, learning as a joint collective enterprise, was encouraged at the expense of metrics. An important lynchpin of AfL was teacher autonomy and reflection so that such practices were to be adapted for the educational context and not to be ritualised.

In 2008 the New Labour government invested £150 million over three years in an AfL strategy for teacher professional development 'to improve the ways in which tests are used' (House of Commons 2008, Ev 178 Q329). AfL became APP, Assessing Pupils' Progress, a means of assessing pupils summatively against hierarchical National Curriculum levels (Swaffield, 2009), precisely the opposite of the ethos of AfL. APP has now become entrenched as common practise.

A second example concerns a group of 16-17 year old students at a school who objected to the presence of sugary drinks dispensers on the grounds of health and effects on learning. The students took their objections to the Principal who claimed the dispensers were beneficial because they raised money for out of school activities which were otherwise unaffordable. The students then drew on more research into the health and learning effects of sugary drinks, organised a campaign, and took their evidence and objections to the School Council, a student-teacher body set up to discuss school issues. The campaign was so successful that the School Council supported the students, the Principal agreed to remove the dispensers and they negotiated new ways of raising money through healthier but appetising drinks (Levinson & Turner, 2001).

The point about these two examples is the contrasting deployment of political knowledge and skills in enacting change for social justice. In the first case, progressive research was appropriated by government power and used for purposes of stratification. Political resistance and organisation were needed to anticipate and oppose such changes. In the second case political *nous* and scientific knowledge were used to muster support: in other words knowledgeable collaborative action together with political and scientific knowledge are presupposed by changes for social justice.

SCHOOLS

An implicit understanding of what has been discussed until now is that SAQs and other science-society educational formulations take place in schools. Schools, at least, are arenas where teachers and students can come together in a common enterprise such as engaging in SAQs. But, as also discussed earlier schools, while being released at least in the U.K.[4] from local control and being deregulated are still under the authority of central government, and are becoming handmaidens to neoliberal drives. Reforms in science education accompanied these changes. The *Beyond 2000* report in the U.K. was ''driven by a sense of a growing disparity between the science education provided in our schools and the needs and interests of the young people who will be our future citizens'' and

[4] Free schools and academies now being promulgated in the U.K. take their lead from the Swedish system and from charter schools in the U.S.

''the rapid pace of technological change and the globalisation of the marketplace have resulted in a need for individuals who have a broad general education, good communication skills, adaptability and a commitment to lifelong learning'' (Millar & Osborne 1998, p. 2001).

The neoliberal assault on school education over the last twenty years has affected teaching and the curriculum as well as school organisation, with a teacher culture focused on short-term outcomes driven by an examination result culture (Hargreaves & Shirley, 2009), a culture of pedagogic conformism and performativity generated through new technologies of control, so that teachers become 'fabricated', change their identity to represent the performative culture of the organisation for appraisal (Ball, 2003).

In the light of such changes political action emanating from critical consideration of technoscientific issues seems a bleak prospect. Teachers are likely to take fewer risks in 'heating up' an issue (Simonneaux, 2014). So, however progressive the intentions of a school management they are unlikely to be effective in such an unpromising political environment. I am cautious about the prospects of SAQs, STEPWISE and SaP because such critical approaches are only likely to achieve little leeway in such a school environment.

While fully recognising that any radical changes to teaching will only come when school reform and teaching are linked to wider social struggles, Fielding and Moss (2011) propose ten indicators of commitment to democratic practices in schools among which are radical roles which characterise relationships as practised between teachers and pupils. I will aim to formulate six principles related to these roles within the context of socio-political scientific issues which are not sufficient in themselves but form the basis of realising meaningful action.

i. *Students as data source*. Students opinions to be taken seriously as related to their own academic achievement and through socio-political issues within the school arena, e.g. support for disabled students, reflection on the science curriculum, school cycling and safety campaigns
ii. *Students as active respondents*. Teachers have a duty to engage in dialogue with students about identifying the kinds of social-scientific issues which concern them, i.e. that these issues *matter* and have *personal meaning* for students, not those which teachers think might be good for students to discuss.
iii. *Students as co-enquirers*. Students encouraged to envisage what participatory research might look like and how it could be enacted,
iv. *Students as knowledge creators*. Students with staff support use their emerging political and scientific knowledge through co-enquiry to suggest change.
v. *Students as joint authors*. Students discuss strategy with peers and staff how change is to be enacted.
vi. *Inter-generational learning as participatory democracy*. Students and staff develop curricular schemes for involving younger students, and to engage extra-school agencies in support for enacting change.

The above suggestions are only a start for what enacted SAQs might look like but a vision which involves shared and negotiated values is a basis for further change.

CONCLUSIONS

I have suggested that the incorporation of political knowledge and literacy through SAQs and a commitment to action would build on a well-worked out pedagogic and curricular base. The process of change would mean negotiating very different regional and national educational territories as well as overcoming performative indicators stemming from a neoliberal hegemony in school education. But the process of change in unpromising environments can generate a fruitful dialectic. The awareness of limitations in what can be achieved can, nonetheless, raise consciousness about the possibilities of action which in itself is a form of action. In the last few years educators in fields in science and mathematics have developed innovative curriculum materials which challenge the STEM discourse, e.g. a mathematics which focuses on redistribution rather than consumer goods, science activities which question the science behind consumer goods, a focus on the technological means of production rather than the hazards of consumption. For example, while there are many activities which focus on the science behind digital technologies and the hazards of radiation, little attention is paid to the scandal of production of coltan (http://www.dailymail.co.uk/news/article-3280872/iPhone-mineral-miners-Africa-use-bare-hands-coltan.html) exposed through a right wing neo-conservative newspaper, one of the contradictions present in SAQs. Fielding and Moss's (2011) indicators of democratic practise provide a not unproblematic way forward but one which has the potential to yield new and productive strategies.

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SOCIALLY ACUTE AGRI-ENVIRONMENTAL QUESTIONS AND CHANGES IN SOCIETY: EDUCATIONAL TRANSITION FOR SOCIETAL TRANSITION VIA THE AGRO-ECOLOGICAL TRANSITION

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ABSTRACT

The debates on the evolution and impact of agriculture on health, on the natural or socioeconomic environment lead us to consider agri-environment issues as socially acute questions (SAQs). The agro-ecological transition towards a more sustainable system, supported by the political authorities, faces a lock-in socio-technical system. Maintaining a teaching of intensive agriculture contributes to this socio-technical lock in. The teaching of socially acute questions can contribute to unlocking to move towards agro-ecological transition, firstly, through innovative educational engineering and participatory learning which constitute niches for innovation and secondly, by entering teaching in a socio-technical landscape within late modernity. Late modernity obliges to distance from the idea of progress or rationality and to consider the political and economic dimensions, uncertainties and risks and the values in agri-environmental issues.

KEY WORDS

SAQ, Agro-ecological transition, Socio-technical regime, Innovation, Late modernity.

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QSV Agroambientais e Transformações na Sociedade: Transição Educacional Para a Transição Societal Via Transição Agroecológica

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RESUMO

Os debates sobre evolução e os impactos na agricultura sobre a saúde, sobre o ambiente natural ou socioeconómico levaram-nos a considerar as questões agroambientais como uma questão socialmente viva. A transição agroecológica para um sistema mais durável, suportado pelas instâncias políticas, é confrontada com um bloqueio do regime sociotécnico. A manutenção de um ensino de uma agricultura intensiva contribui para este bloqueio sociotécnico. O ensino das questões socialmente vivas podem contribuir para o desbloqueio orientado para a transição agroecológica, por um lado, graças às ingerências didáticas inovadoras e participativas que constituem as inovações de nicho, e por outro lado, inscrevendo o ensino numa paisagem sociotécnica relevante da «modernidade tardia». A modernidade tardia obriga a considerar alguma distância relativamente à ideia de progresso ou de racionalidade e a considerar as dimensões políticas e económicas, as incertezas e os riscos, assim como os valores, nas suas problemáticas agroambientais.

PALAVRAS-CHAVE

QSV, Transição agroecológica, Regime sociotécnico, Inovações, Modernidade tardia.

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QSV AGRO-ENVIRONNEMENTALES ET CHANGEMENTS DE SOCIETE : TRANSITION EDUCATIVE POUR UNE TRANSITION DE SOCIETE VIA LA TRANSITION AGROECOLOGIQUE

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RESUME

Les débats sur l'évolution et les impacts de l'agriculture sur la santé, sur l'environnement naturel ou socio-économique conduisent à considérer les questions agro-environnementales comme une question socialement vive. La transition agroécologique vers un système plus durable, soutenue par les instances politiques, est confrontée à un verrouillage du régime sociotechnique. Le maintien d'un enseignement d'une agriculture intensive contribue à ce verrouillage sociotechnique. L'enseignement des questions socialement vives peut contribuer au déverrouillage pour s'orienter vers la transition agroécologique, d'une part, grâce à des ingénieries didactiques innovantes et participatives qui constituent des innovations de niche, et d'autre part, en inscrivant l'enseignement dans un paysage sociotechnique relevant de la « late modernity». La late modernity oblige à prendre quelques distances avec l'idée de progrès ou de rationalité et à considérer les dimensions politiques et économiques, les incertitudes et les risques ainsi que les valeurs dans les problématiques agroenvironnementales.

PALAVRAS-CHAVE

QSV , Transition agroécologique , Régime socio-technique , Innovations , *Late modernity*.

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Socially Acute Agri-environmental Questions and Changes in Society: Educational Transition for Societal Transition Via the Agro-Ecological Transition

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Agriculture has become considerably intensive since World War II thus increasing both its production and productivity. Intensive farming emerged when food was short and gradually profitability became the dominant focus.

Various negative impacts were denounced in the early stages as is the case with so many Socially Acute Agricultural (environmental or health) Questions but despite the fact that this form of farming was called into question, a socio-technical lock-in stunted the development of alternative agricultural models. It is only recently that French agricultural policy has started trying to generalize a different socio-technical regime, that of agro-ecology which in turn has become a Socially Acute Question. In this paper we analyse how the education system, in particular the teaching of SAQs, contributes either to the lock-in or, on the contrary, to a societal transition within the agricultural, agri-food and environmental fields.

THE THEORY OF TRANSITIONS TO SUSTAINABILITY

Within the framework of the theory of transitions, Geels and Shot (2007) propose a multi-level and structural perspective (MLP) for analysing transitions to sustainability. They define three analytical levels: i) niches (the locus for radical innovations), ii) socio-technical regimes (the locus of established practices and associated rules that stabilise existing systems), and an exogenous socio-technical landscape. Transition is a non-linear process that results in the shift from one socio-technical regime to another under the pressure and the interactions of the other two levels (cf. fig1).

A socio-technical regime is a process consisting of « cognitive routines and shared beliefs, capabilities and competences, lifestyles and user practices, favourable institutional arrangements and regulations, and legally binding contracts » p. 27. In the farming context, the routines are characterised by the actors' adherence to a particular professional genre, in this case the efficient farmer genre, which prevents the emergence of an alternative socio-technical system (Frere, 2014; Lipp, 2014; Vidal & Simonneaux, 2013). These technical, socio-cultural, economic and political systems develop alongside each other in a manner consistent with the equipment, organisation and skills. The socio-technical regimes are characterised by the lock-in mechanisms which restrict innovations and transitions.

According to Geels and Shot (2007), at the micro level, niche innovation is developed within protected spaces (laboratories, demonstration projects, new markets…) by small, often marginal, actor networks. These niches are crucial to the emergence of socio-technical transitions. In the case of the agro-ecological transition, niche innovation does not necessarily occur within protected spaces but rather takes place on innovative farms where a network of actors co-construct new distributed knowledge with or without the collaboration of researchers or agricultural development agents.

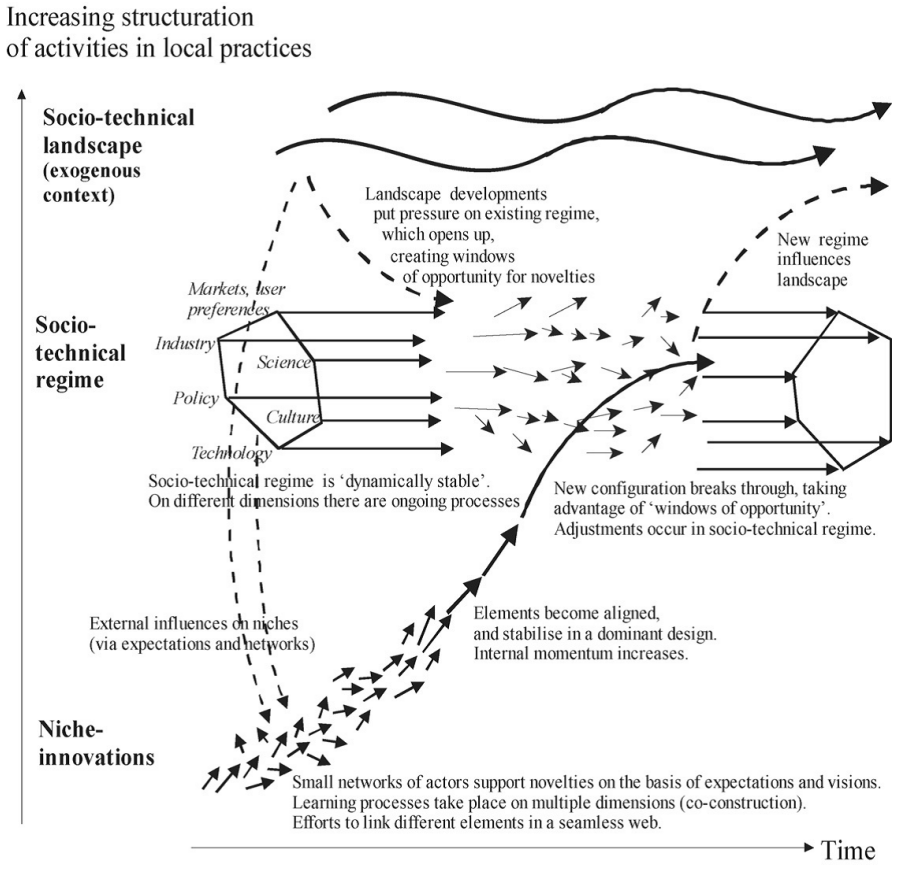

Figure 1. Multi-level perspective on transitions.
[Geels & Shot (2007) adapted from Geels, 2002, p. 1263.]

The socio-technical landscape represents a macro economic, cultural and political context with a high force of inertia. This theory is based on a systemic approach which sheds light on the processes at play over time in the choice of a technological trajectory. Each system is characterised by the tension between technologies, politics, an economic context and society's values which gradually establish a dynamic balance that will guide its development. The interests of each individual stakeholder on the same trajectory are strengthened by the others' choice. This lock-in is thus characterised by "a wide range of stakeholders at all levels of a specific sector and within the institutions concerned, a socio-technical trajectory which "locks-in" over time and prevents certain loopbacks

because of the close coordination between the various components, despite the impasses that may characterise it, and marginalise alternative trajectories" (Lamine et al., 2011, p. 124).

The agro-ecological transition represents a change of socio-technical regime. The socio-technical regime may be unlocked by an incremental diffusion, in the form of transition, of niche innovations which can emerge in farm production systems (Meynard et al., 2013).

By questioning the economic and political rationale we are able to identify and analyse the socio-technical lock-in points of an agro-ecological transition (Baret et al., 2013; Meynard et al. 2013). These authors identify the lock-in mechanisms of socio-technical systems by analysing the network of stakeholders, the norms and the knowledge. Lock-in is a situation in which "a dominant technology prevents the development of alternative trajectories" (Baret et al. 2013, p. 6).

INTENSIVE FARMING: A LOCKED-IN SOCIO-TECHNICAL REGIME

ESTABLISHING A SOCIO-TECHNICAL LOCK-IN

Since World War II, French agricultural development has been based on a mechanised, motorised and "chemical" farming model. This socio-technical system targets, first and foremost, an increase in productivity, an improvement in technical aspects, an intensification and integration of farming into the rest of the economy. Scientific, technical, economic and political means have been mobilised to this purpose.

The paradigm of agricultural modernisation and the paradigm of productivism

The paradigm of productivism refers to a way of organising the economy with production as the primary objective and is based on the large-scale use of (renewable and non-renewable) resources and inputs. From this perspective, in order to be lasting, the system needs sufficient outlets for its products and a significant mastery of farming techniques (Allaire & Boyer, 1995; Lowe, Murdoch, Marsden, Munton & Flynn, 1993).

The notion of a technological paradigm (Dosi, 1982; Gaffard, 1990) was introduced to discuss the processes of technological change. Thus, the technological paradigm represents a model of solutions to selected technical and economic problems. Technological innovation design is regarded as an activity for solving a particular problem. The technological paradigm defines how these innovations emerge and how they develop. Following on from this work, the chemical or pesticides paradigm was put forward to describe the heavy reliance of wine growing systems on chemical inputs including pesticides (Saint-Gès, 2006; Ugaglia, Del'Homme & Filippi, 2011).

In the area of pest control, agronomy gave way to the industrial pesticides industry (international firms and their research and development departments). In this way, crop protection management was modernised and split into different sectors (insect, disease and weed management). Agronomy was applied to the task of intensifying crops by introducing a growing number of techno-scientific innovations based increasingly on the chemical paradigm: using pesticides is both implicit and systematic in crop protection strategies. These orientations led to a massive increase in standardised production. Productivist systems endeavour to reduce production costs resulting in increased labour productivity. To do so they integrated techno-scientific innovations (mechanisation, chemicalisation) via specialisation and intensification, producing a large quantity (maximisation of returns) of standard foodstuffs.

Research then began on genetically modified « pesticide-plants »: firms and groups involved in biotechnology joined forces to find new ways of increasing plant resistance particularly to herbicides. In the 1970s, parallel to the advent of the farm supply and agri-food industries, the development of supermarkets accentuated this process of standardisation. So we shifted to a farming system, regulated to an increasing extent by a market dominated both upstream and downstream by industry and accompanied by the standardisation of food consumption habits. Agricultural policy progressively, detached itself from market management.

However, this intensive system raises questions. When evoke productivist systems, it is effectively a derivative of intensification we are highlighting: the negative externalities (pollution, the uniformity of landscapes, deterioration in the sanitary quality of food due to pesticide residues for example) adversely affect the benefits / risks balance of the intensification process. One can even consider that this type of approach in itself contributes to the lock-in effect inducing an economics-based reasoning. We should not forget that yield and the economic margin were two indicators used to validate the logic of intensification for farmers. Yet they reveal signs of weakness in the conventional intensive systems: on the one hand yields are stagnating and profit margins declining for arable crops amongst others, and on the other hand price volatility means that prices no longer cover production costs within the context of a reduction in direct payments for production. How can we explain that the intensive farming model, based on the use of chemicals in crop protection management, has not yielded to criticism, to the proof that it has detrimental effects even on the very health of farmers and to the evidence of the success of alternatives to pesticides? It is this question we discuss in the next section.

The socio-technical lock-in mechanism

At the origin of a coherent socio-technical lock-in system, five salient features can be identified (Bonneuil & Hochereau, 2008; Lamine et al., 2010 , 2011; Vanloqueren & Barret, 2009) i) the notion of a single model of development supported by the positivist roots of the sciences and an idea that techno-scientific innovation is associated with progress; ii) the “mining” of water, soils and biodiversity considered to be raw materials and the use of certain types of inputs (synthetic fertilizers, pesticides, irrigation, elite varieties,…); iii) the limitation of system complexity iv) the modes of support offered in

Northern countries which have fostered “industrialised” farming; v) a tightened governance of the agricultural profession sharing the vision of an industrialised form of agriculture open to export.

With the advent of post war industrialised farming, a socio-technical system developed locking out the alternatives to synthetic pesticides. In keeping with the global agricultural intensification policy based on maximizing returns, chemical pest control took the upper hand because of its user-friendliness, its efficacy and also its cost-effectiveness. Nevertheless, the underpinnings of this system pushed to its limits were to be progressively discredited. The use of pesticides as an exclusive remedy soon revealed its limits. But the socio-technical system developed coherence over time, reinforcing stakeholders’ interests and resisting criticism in a large number of production systems. This resulted in a trajectory lock-in: alternative solutions to synthetic pesticides, even though they were based on robust evidence of their relevance, fail to impose themselves and are ruled out thus becoming inaccessible (Lamine et al., 2011; Vanloqueren & Baret, 2009). This lock-out still prevents the socio-technical system (the farmers, the farming sectors, the research-development-training framework, politicians and consumers) from reorienting farming practices.

Lock-in is a situation where « a dominant technology prevents the development of alternative trajectories” (Baret et al., 2013, p. 6). The introduction of alternative techniques comes into confrontation with an existing socio-technical organisation. For example, although technical solutions exist, growing associated crops such as durum wheat / leguminous vegetables comes into conflict with the marketing and processing system in the plant sector because the latter is organised by product (Magrini et al., 2013). It’s the same for many innovations (mechanical weeding…). The dominant agricultural advisory council is formatted and often funded by agrochemical firms that lock-in any change in agronomic practices for economic and technical reasons. We cannot change farming practices without considering what happens at the upstream and downstream levels, that is to say, what happens in the farm supply industry, but also in supermarkets and with consumers.

To go beyond the traditional economic approach to intensification, Bonny (2010) points out that other factors are also relevant, such as knowledge, information, ecosystem services. As far as knowledge is concerned, traditional knowledge and local knowledge have been discredited in favour of scientific and technical knowledge (Jas, 2005). The prevalence of the latter can be explained both by the idea of progress, of which they were considered to be the driving force, and also because they were incorporated into goods and services (advice, decision-making tools). Farmers broadened their knowledge of plant needs, of how to recognise pests, and how to use phytosanitary treatments during the course of the crop season. Their knowledge of chemical pest control became more and more sophisticated; knowledge of alternatives to pesticides and ecosystem dynamics was set aside. This drift was reinforced by the type of information made available and accessible to them:

- on the one hand Information on chemical pest control, on phytosanitary products and on their mode of action for target groups and by crop type, were widely distributed by firms and agri-supply technicians;
- on the other hand, information on ecosystem services, especially those which contribute to pest control, was mediocre for arable crops (the action of biological

control agents, interaction processes). Information on alternative systems remained confined to specific networks (i.e. organic systems). Information on environmentally friendly systems did not filter easily into professional circles.

SUPPORT FROM THE EDUCATION SYSTEM

The specificity of the French agricultural education system lies in the fact that it is part of the Ministry of Agriculture and not of the Ministry of Education. Moreover, the agricultural education system has always relayed the Ministry of Agriculture's political and economic choices concerning the development of farming. In the early 1960s and the Pisani Laws, agricultural education was already considered as a lever for the implementation of agricultural policies it being one of the training channels for future farmers and a means of getting them to adhere to the modernisation and intensification of farming. Agricultural education was engaged in and indeed institutionalised, the entire process of an intensive and chemical form of agriculture. The aim of agricultural education was to promote intensification techniques which were also backed by firms, banks and professional organisations. The generalization of the techno-sciences was supported and relayed by schools ensuring that the farmers adhered to the intensive model of the thirty year post war boom.

We can consider that, over a substantial period of time, agricultural education was one of the elements involved in the lock-in of an intensive agricultural system since education helped to reinforce the various (political, scientific, technological, etc.) dimensions of the socio-technical regime as well as the agricultural extension system as a whole.

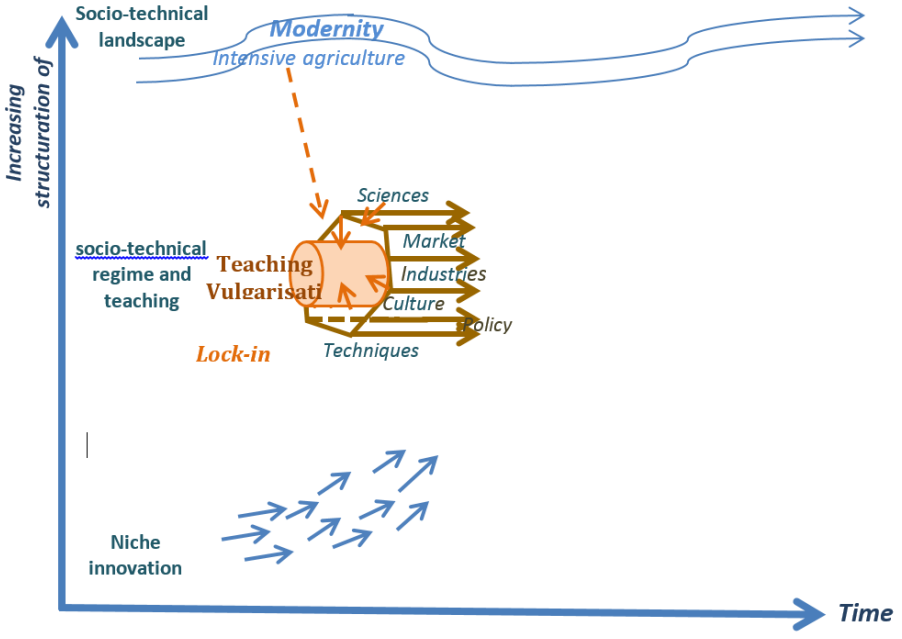

Figure 2. Contribution of agricultural education to the socio-technical regime.

THE AGRO-ECOLOGICAL TRANSITION

FROM THE EMERGENCE OF AGRO-ECOLOGY TO THE AGRO-ECOLOGICAL TRANSITION

The limits of the intensive agricultural system emerged very quickly (impacts on the environment, food quality, farmers' and consumers' health, agricultural employment, and farmers' dependence on agro-chemical firms). In the field of agronomy, new pesticide molecules also revealed their limitations; examples of resistance to pests are multiplying all over the world. However, because financial stakes are so high, the environmental or health risks are played down in the dominant political discourse. Society began to express strong concern, in particular about the increase in pollution, the media coverage of breeding conditions and the emergence of crises such as that of BSE in the early 2000s. The pressure of social demand has given rise to a new kind of institutional activism (European or French, as the case may be) in the defence, for example, of animal welfare or a reduction in the use of pesticides.

It is within this context that the concept of organic farming emerged becoming officially recognised in 1980 with its own set of specifications. The notion of sustainable agriculture followed in the late 1990s parallel with the concept of sustainable development and then more recently in 2014 "producing otherwise" emerged as the political ambition of the Minister of Agriculture and was approved in the French Act for the future of farming as a support for agro-ecological agricultural systems. This legislation introduces the notion that agriculture must make sure that economic, social, and environmental and health performances converge. Furthermore, this project can be assimilated to a form of sustainable agriculture, since organic farming is considered to be one of the forms of agro-ecology.

The evolution, complexity, multidimensionality and variation of the situations in which the concept of agro-ecology is used, make it an SAQ, just like sustainable agriculture or organic farming. Strictu sensu, it would certainly be inaccurate to talk in terms of a weak or strong agro-ecology in the same way we talk about weak or strong sustainability. However, the term agro-ecology is used and viewed from different perspectives. With a view to food and energy sovereignty, the principles put forward in agro-ecology are: the respect for natural resources (biodiversity, ...), social equity, a reduction in the use of inputs, particularly those of non-renewable origin, and the resistance to external economic vagaries (Altieri, 2002; Koohafkan, Altieri & Gimenez, 2011).

Agro-ecology should make it possible to develop both an agro-food system which is autonomous vis-à-vis the exterior and systems which are resilient to external hazards, whether these hazards are natural or socio-economic. Amongst other aspects, agro-ecology corresponds to (i) the notion of organic farming, bio-dynamics or permaculture (ii) conservation agriculture (concerning soils), which advocates no-till, simplified cultivation techniques and establishing vegetation mantles (Iii) precision farming, (iv) promoting the expression of ecosystem services such as the production of oxygen from the air, water purification, biomass production and recycling, improvement of biodiversity, reduction of water or nutrient losses, pollinator activity, etc., v) ecologically

intensive or double-green farming, which must be economically efficient, vi) areas of biotechnology such as the production of transgenic plants designed to reduce the use of pesticides.

Depending on our how we look at agro-ecology, it may or may not carry alternative principles in the field of agricultural development or in the socio-economic domain in the face of the consumer society integrating social and ethical dimensions. In this case, agro-ecology corresponds to an emancipatory social movement, but it can also be used as a "green" slogan to defend transgenic agriculture and its financial interests.

In the light of the theoretical framework presented here, the agro-ecological transition may be regarded as a change of socio-technical regime. The socio-technical regime can be unlocked by a gradual spread, in the form of transition, of niche innovations that may emerge in agricultural production systems (Meynard et al., 2013). By questioning the economic and political rationales we are able to identify and analyse the socio-technical lock-in points of an agro-ecological transition revealed through a socio-technical approach (Baret et al., 2013; Meynard et al.). These authors identify the socio-technical lock-in systems by analysing the network of actors, the norms and the knowledge.

CHANGES IN THE AGRICULTURAL EDUCATION SYSTEM

With the changes in European and French agricultural policies beginning in the 1980s and the surge in environmental policies, the agricultural education system gradually integrated the new orientations, particularly those concerning the environment. Integrating, for example, organic farming, sustainable agriculture and finally agro-ecology into educational programmes is a significant aspect of the process of innovation and change: this process was first based on a few individual initiatives, then encouraged on specific or optional courses and finally recognized in the majority of diplomas and on the majority of the farms found in French agricultural high schools (see box below). Although these innovative additions were initially marginal or sometimes optional, significant changes occurred; first in the late 1990s then in the years 2007/2008 with the generalisation of support for sustainable agriculture and development and more recently, the “teaching to produce otherwise" scheme launched in 2014 in line with the new French Act for the future of farming. These changes are noteworthy insofar as they have led to changes in all the curricula, to the introduction of various support measures, to training and to teacher networking (the organic farming network, the education for sustainable development network, etc.) and also to specific actions (carbon footprint assessment, pesticide reduction plan, etc.).

The techno-scientific, social, political and economic choices made by the Ministry of Agriculture when (re)designing the curricula, may occasionally reflect a kind of schizophrenic attitude as a result of the need to accommodate economic interests and a farming system which remains largely intensive. Indeed, parallel to the new agro-ecological rhetoric, the dominant productivist model is still largely prevalent today, especially in the fields of economics and management. This raises the question of the driving force, the magnitude and the nature of techno-scientific and educational change.

THE CONTRIBUTION OF THE TEACHING OF SOCIALLY ACUTE AGRI-ENVIRONMENTAL QUESTIONS TO UNLOCKING

If we place our reflection within the frame of Geels and Shoot's (2007) model of the transition to sustainability, a change in the socio-technical regime occurs only when niche innovations and a new socio-technical landscape are combined. In this paper we propose to demonstrate how the teaching of agro-environmental SAQ (AESAQ) acts as both a niche innovation and as a new socio-technical landscape.

THE NICHE INNOVATIONS OF AESAQ

The teaching of SAQs is based on different forms of didactic engineering. The term "engineering" used here may be similar to or incorporate what some call modalities, didactic systems, or didactic strategies depending on the ambitions and the specificities of the didactic situation. These forms of didactic engineering are specific and are based on a variety of levers and tools. Among these engineering types, research on SAQs has covered:

- debates and role plays (Simonneaux, 2001) developed from the perspective of a well-argued position and which were the first engineering devices often associated with SAQs,
- epistemological disturbances (Simonneaux, Simonneaux & Chouchane, 2014) which operate on the basis of the presentation of scientific data or results considered reliable but contradictory. This introduces an element of doubt by calling into question the opinions and previous knowledge of participants,
- intercultural student exchanges (Morin et al., 2013) that facilitate the emergence of and reflexivity on value systems,
- collaborative writing (Morin, Simonneaux & Simonneaux, 2013) to facilitate interaction at distance,
- meetings between researchers and students (Molinatti, 2011; Panissal, Brossais & Vieu, 2010), which question the representations of how research functions and the role of researchers,
- serious games (Simonneaux, Leboucher & Magne, 2014; Simonneaux, Simonneaux & Vidal, 2010) to motivate students, encourage interactions and simulations,
- problem situations (Simonneaux & Cancian, 2013) to encourage the students to use the process of problematisation,
- the Forum Theater (Bérard & Simonneaux, 2015) to foster co-construction and critical engagement,
- dilemmas (Lipp, 2016) to introduce ethical questions,
- the 'démarche d'enquête' (research under way within the framework of the European PARRISE project).

Although these didactic techniques have been used to tackle different AESAQs and are based on a variety of didactic situations, their implementation is in fact more frequently an association of several modalities (debate + collaborative writing, debate + meeting with researchers ...). But above all, what all these techniques have in common is that they encourage interaction between learners integrating what is "already there" into the process of knowledge construction and develop a critical reflexivity on knowledge, principles and values. These didactic devices actually correspond to niche innovations insofar as they are implemented on the initiative of individuals or by a network of actors and are limited in time and space. All these techniques are combined in the process of innovation and the dynamics of change, to question the different components (economic, cultural, scientific, political ...) of the socio-technical system.

THE SOCIO-TECHNICAL LANDSCAPE OF THE AGRO-ECOLOGICAL TRANSITION IS IN KEEPING WITH LATE MODERNITY

These techniques and SAQ didactics in general, have a specific epistemological framework in common which is new to the school environment and which in fact constitutes a new socio-technical landscape.

The link between the technosciences-companies, farming systems-companies, and their connections with education can be viewed from a socio-historical perspective. This amounts to positioning education within the ternary framework of pre-modernity, modernity and post-modernity. Does the ternary framework of pre-modernity, modernity, postmodernity reflect the gradual emancipation of the individual in society? Pre-modernity is based on tradition and / or religion. Modernity is connected with the ideal developed by the philosophers during the Enlightenment period. Authority and tradition are replaced by reason and science, which will allow progress based on so-called true and objective knowledge. Modern science should allow Man to dominate nature. Capitalism appears as a new mode of production and consumption supported by technological innovation. Modernity goes hand in hand with a growing trend towards individualisation. Education should free the individual through rational knowledge. Overestimated scientific knowledge is transmitted in a top-down process. Scientists, techno-scientists, hold a privileged position; they are the experts who replace the priests of pre-modernity. The link between scientific reasoning and social, moral, ethical reasoning is not questioned. Modernity has favoured the emergence of the socio-technical regime of intensive agriculture, which seems to be the finalised version of man's control over nature.

We observe that the following period is more difficult to define, that authors have proposed different models or “ideal-types” (post-modernity, late-modernity, reflexive modernisation, advanced modernity, second modernity, etc.). For some, modernity is still prevalent and must be defended (Habermas). Others consider that we have entered into a period of post-modernity. The hope set on progress has been shaken up by the dangers associated with the technosciences (nuclear weapons, pollution, health

Table 1

From modernity to late modernity (Table produced with the contribution of Levinson).

	Time	Main ideas	Educational Regime	Socio-technical agricultural regime
Pre-modernity	Antiquity and medieval times	Search for models in nature. A hierarchical view of society	Elitist and scholastic	
Modernity	From 17th to 20th century or even up to today	Global idea of Enlightenment, of rationalist science. Rationality is superior to other ways of thinking. Logical positivism, Karl Popper. Empiricism. Mertonian sense of the important values of science such as the search for truth, objectivity, impartiality, etc.	The laypersons need to know more science to appreciate and support good politics. Necessity to think scientifically. Understand science first, then apply it to society. Social, moral, ethical reasoning is not questioned.	Intensive farming
Late modernity	Since the mid 20th century	Science is considered to be impregnated with power relationships. The link with society is problematic and complex. Science has a role, but is sensitive to economic, political and cultural dynamics. Ideologies, values are recognized. Post-normal science (Funtowicz and Ravetz) and even relativism. Risk Society (Beck)	Contextual and situated Education Complexity and uncertainty taken into account. Socio-scientific Reasoning, moral reasoning SAQ Sustainability education Scientific, economic and political education	Agro-ecological transition

problems). Hope in the future has been replaced by a concern for the future linked to the worries associated with the harmful effects of the capitalist model especially its effects on the environment. The link between the technosciences / agriculture and companies has become problematic and complex. It has been acknowledged that research and its applications, cultural norms, socio-political and economic contexts influence each other. Scepticism, even pessimism, has replaced the optimism of modernity. Relativism has developed alongside the recognition of true and objective knowledge. The traditional image of science has changed. Research is criticised because it has become increasingly affiliated with the financial interests of firms. According to Latour, modernity's arrow of time and its consequent progress is not moving in a straight line. "The old idea of progress, which we have recently abandoned, allowed us to throw caution to the wind; it freed us from all prudence and precaution. The new idea seems to prone caution,

selective choice and careful consideration of the possible outcomes "Latour, Le Monde, August 24, 1996.

Beck refuses the post-modernist approach. He considers that we are in a period of new modernity, but that we remain within the modernity era. He considers that we are shifting from industrial modernity to reflexive modernity. He describes this period as the "risk society". Beck (1986, 2001) suggests that society is preoccupied with the risks related to the technoscientific solutions found to solve to our problems. The production of new scientific knowledge, particularly in the field of agriculture, ultimately addresses the multiple impacts (waste, pollution, new diseases) that have been generated by the technosciences. The negative effects of intensive farming were denounced very early on, but because of the socio-technical lock-in, the alternatives were not considered or even heard about. The agro-ecological transition project is in keeping with reflexive modernity, whilst the emphasis is increasingly placed on the accumulation of the environmental and health risks. Following on from Beck's analysis, in our society, scientific rationality is not sufficient to justify a technoscience; it needs to be accompanied by reflexive criticism of its potential impact. Beck believes that confronted with the risk society, crises and uncertainty, individuals will develop a reflexive modernity, alternative rationalities will come to light and new social movements, what he calls 'subpolitics' will emerge in the interstices of what is held to be the official society. Beck's ideas are sometimes criticised for being strictly theoretical, unsupported by empirical work. Jensen & Blok (2008) put his theory to the test in a case study on how the use of pesticides was perceived in Denmark. Their aim was to study whether or not the Danes lived in what Beck refers to as a risk society. They observed in their study that laypersons had different "risk habitus" (p.755), in particular they were less worried if they were confident that a form of ecological modernity existed guaranteeing control. « While a majority of lay-people (and a minority of counter-experts) may be said to broadly inhabit a 'risk' society, a majority of experts (and a minority of lay-people) rather inhabit an 'ecological modern' one ». They consider that « as a societal narrative, 'risk society' is therefore clearly contested » (Mol & Spaargaren, 1993, p. 773) and by the same also contest Beck. They advocate an alternative paradigm of "ecological modernisation" with green lobbies to secure environmental interests. Ecological progress would therefore prevent the risk society from existing. If this is the case, the techno-economic progress of modernity will take place, under the control of ecological progress.

Giddens (1994) also rejects the notion of post-modernity. He refers to advanced modernity to describe where we are today. For him, no knowledge is definitively stabilised and progress is a myth. According to Therborn (2003) "multiple modernities" coexist, that is to say that people live different lives (traditional, modern, "late" modern) although they share the same society. This is similar to Douglas's (1985) point of view which highlights the cultural impact, judgment and risks. She considers that, people within the same culture, may not all have the same appreciation of risk. Thus, social prejudice influences a person's perception of risk. According to Lipovetsky and Charles (2004), a hypermodern society has emerged and replaced postmodern society because of the anxiety linked to an awareness of the serious problems caused by environmental, socio-economic, or health disorders.

SAQs can be situated within the field of post-normal science (PNS) as defined by Funtowicz and Ravetz (1993) because they are a science closely related to human needs, involving significant uncertainties, problems and values, and requiring urgent decision-

making. According to Ravetz (1997), the question "what if?" justifies taking all available data into consideration, including that which comes from sources outside orthodox research. These authors emphasize that the decision-making process in the field of PNS should include an open dialogue with all parties concerned. They introduce the notion of an "extended peer community". It is important to train students to participate in this "extended peer community". As the word of the experts is not taken as gospel everyone must get involved in the decision-making and act both individually and collectively. “We have no choice but to choose how to be and how to act” (Giddens, 1994, p. 75).

From the point of view of the reflexive modernisation desired by Beck (1986/2001), we have to go beyond « successive attempts to rescue the "underlying rationality" of scientific knowledge » (p. 360) implemented whenever science is faced with failure or adverse effects. In the research cited above, Jensen & Block (2008), referring to Latour (2003), conclude that the value of Beck's work lies in its 'performative' dimension. Indeed, it is with this in mind that we view SAQs with great interest because reflexivity on modernisation is not straightforward. It is necessary to create an awareness of the vital importance of this reflexivity through “educ-action”, that is to say an education that focuses on how we function and act collectively and individually. This is in keeping with SAQs which advocate that citizens should remain vigilant, that they should not shirk this responsibility by relying on an ecological governmental form of control. To what extent should this reflexivity be developed? Should education prone exercising reflexivity on "expert knowledge" or allow students to generate their own knowledge on risks? The aim of “educ-action” is to encourage not only the involvement of students and teachers, but also their engagement in individual and collective action, what Beck described as 'sub-political' engagement. In this respect, the SAQ approach defends an education which is humanistic, scientific, political and economic.

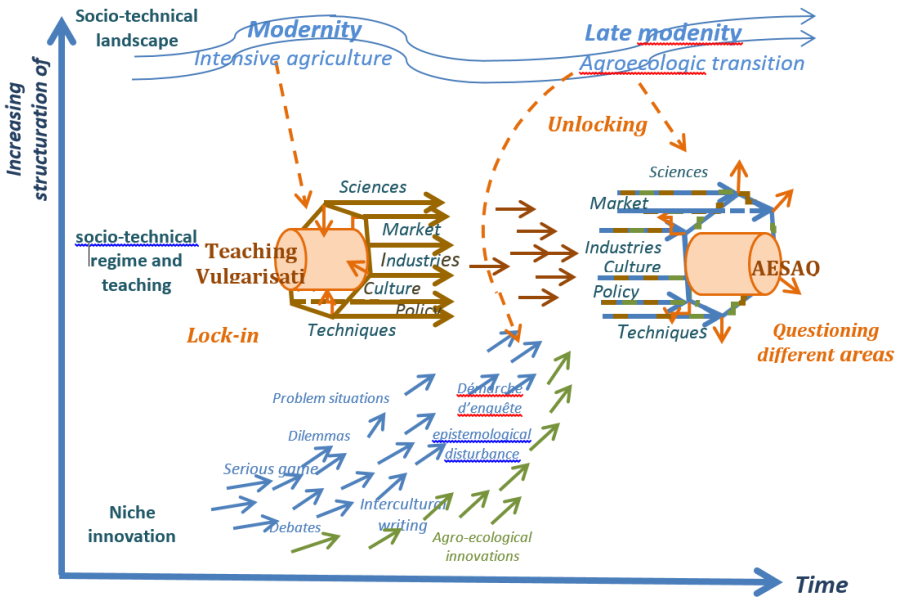

Figure 3. Contribution of SAQ to change the socio-technical regime.

CONCLUSION

Geels and Shot's (2007) model of the transition to sustainability is interesting because it regards change from a global point of view, integrating different levels of analysis (niche, regime, landscape) and different foci, (technical, political, the sciences, the market ...). It seems to us that their model can be extended to the possible and / or desired educational transitions towards increased sustainability concerning agriculture and food.

In terms of SAQs, their model shows how, from a "late modernity" perspective, SAQ didactics are consistent with the agro-ecological transition. Promoting the transition to the "teaching to produce otherwise" model, desired by the ministry in charge of agriculture should lead us to systematically question the different areas of the socio-technical regime. Therefore, the SAQ approach should not only contribute to scientific culture, but should also aim at developing students' political culture by including topics such as risk analysis, the analysis of political and economic governance, decision-making and action. A threefold educational orientation is necessary: a scientific, socio-economic and political "educ-action". SAQ didactics should contribute to the emergence of the critical education which is, in our opinion, essential to the development of emancipated eco-citizens. Curricula should be transformed in accordance with this critical education. We see this as a crucial step in addressing the challenges facing today's society as well as those it will face in the future.

We see many similarities between the SAQ approach and the STEPWISE programme (Science and Technology Education Promoting Wellbeing for Individuals Societies and Environments) in terms of their scientific, social, political and economic education objectives (Bencze, Sperling & Carter, 2012), but we also observe similarities with the humanistic approach to teaching science advocated by Freire. "This (humanist) argument brings to discussion to the need of transforming scientific and technological modern society through human values, preparing the students for a society in which sustainable knowledge and responsible action are the norms. This is not an anti-technology movement, but a movement against a particular model of economic development and technological practice" (Santos & Mortimer, 2002, p. 646). The inclusion of SAQs in education is necessary, but it should integrate not only questions on scientific content, but also "the understanding of environmental risks; the power of domination that the technological system impinges in culture; the difference between human needs and market needs; and the developing of attitudes and values consistent with a sustainable development" (Santos & Mortimer, 2002, p. 647).

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ENSEIGNER DES QUESTIONS SOCIALEMENT VIVES : UN CHAMP DE TENSION ENTRE L'EDUCATION TRANSMISSIVE ET L'EDUCATION TRANSFORMATRICE-CRITIQUE

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RESUME

Cette contribution se propose d'aborder l'intégration de la problématique des questions socialement vives dans la formation des enseignants à partir de l'exemple d'une recherche sur l'éducation au développement durable (EDD). Elle s'appuie sur des données recueillies dans le cadre d'une recherche sur les représentations sociales du développement durable (DD) et les postures au regard de l'EDD de futurs enseignants français et québécois. Le cadre théorique, – construit autour des concepts de questions socialement vives et de pédagogie critique –, ainsi qu'une posture transformatrice-critique, orientent la lecture et l'interprétation des résultats, notamment en soulignant la coexistence de deux approches de l'EDD chez les futurs enseignants : l'une transmissive et l'autre transformatrice-critique. Cela se traduit par des champs de tension se rapportant notamment aux questions de neutralité et de finalités. Le présent article se propose d'illustrer la manière dont ces tensions se manifestent chez les futurs enseignants à partir de résultats issus de douze entretiens semi-directifs. Il apporte ainsi un éclairage approfondi et renouvelé quant aux appuis et obstacles à l'implémentation des questions socialement vives dans les systèmes éducatifs formels.

MOTS-CLES

Éducation transformatrice-critique , Pédagogie critique , Questions Socialement Vives , Postures d'enseignants , Éducation au développement durable, Interdisciplinarité.

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TEACHING SOCIALLY ACUTE QUESTIONS : A TENSION FIELD BETWEEN TRANSMISSIVE EDUCATION AND CRITICAL TRANFORMATIVE EDUCATION

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ABSTRACT

This paper proposes to discuss the implementation of socially acute questions into teacher training on the example of education for sustainable development (ESD). We describe a study which aims to identify how future Quebecois and French teachers represent sustainable development and ESD. A theoretical framework built around the concepts of socially acute questions and critical pedagogy together with a critical-transformative posture guide the reading and interpretation of the results, highlighting the emergence of some areas of tension identified among the future teachers interviewed; these reflect the existence of two approaches to ESD: one transmissive and the other critical-transformative. These tensions are related to questions of neutrality and teaching and learning goals. Based on results from twelve semi-structured interviews, this article is to illustrate how these tensions are manifested among the future teachers. It thus provides an in-depth, up-to-date clarification of the factors that support or hinder the teaching of socially acute questions in formal education systems.

KEY WORDS

Critical-transformative education, Critical pedagogy, Socially Acute Questions, Teachers' postures, Education for sustainable development, Interdisciplinarity.

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O Ensino das Questões Socialmente Vivas: um Campo de Tensão Entre Educação Transmissiva e Educação Crítico-Transformativa

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RESUMO

Esta contribuição propõe abordar a integração da problemática das questões socialmente vivas na formação de professores a partir do exemplo de uma investigação sobre a educação para um desenvolvimento sustentável (EDS). Baseia-se em dados recolhidos no quadro de uma investigação sobre as representações sociais sobre desenvolvimento durável (DD) e sobre as posturas e o olhar de futuros professores Franceses e do Quebec sobre EDS. O quadro teórico – construído em redor de conceitos sobre questões socialmente vivas e da pedagogia crítica –, assim como uma postura crítico-transformativa, orientam a leitura e a interpretação dos resultados, especialmente enfatizando a coexistência de duas abordagens sobre a EDS nos futuros professores: uma transmissiva e outra crítico-transformativa. Isto traduz-se em campos de tensão reportando-se, nomeadamente, a questões de neutralidade e de objetivos. O presente artigo propõe ilustrar a forma como estas tensões se manifestam nos futuros professores a partir de resultados de doze entrevistas semidiretivas. Pretende também ilustrar de forma aprofundada e renovada os suportes e obstáculos à implementação de questões socialmente controversas em sistemas de educação formal.

PALAVRAS-CHAVE

Educação crítico-transformativa, Pedagogia crítica, Questões Socialmente Vivas,
Atitudes dos professores, Educação para o desenvolvimento sustentável, Interdisciplinaridade.

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Enseigner des Questions Socialement Vives : un Champ de Tension Entre l'Education Transmissive et l'Education Transformatrice-Critique

Jeziorski Agnieszka

INTRODUCTION

Cette contribution propose d'aborder l'intégration de la problématique des questions socialement vives (Legardez & Simonneaux, 2011) dans la formation des enseignants à partir de l'exemple d'une recherche sur l'éducation au développement durable (EDD). Plus précisément, l'étude faisant l'objet de cet article vise à dégager des postures de futurs enseignants en France et au Québec au regard de l'EDD et de situer celles-ci dans la grille d'analyse proposée par Jickling et Wals (2008) qui distinguent deux conceptions de cette « éducation à » : l'une transmissive et l'autre transformatrice-critique. Pour cerner les postures des futurs enseignants, nous nous appuyons sur des données recueillies dans le cadre d'une recherche plus large qui avait pour objectif d'identifier les représentations sociales du développement durable (DD) et les postures au regard de l'EDD (Jeziorski, Legardez & Bader, 2015) en utilisant deux outils complémentaires : le questionnaire et l'entretien. Pour les fins de la présente contribution, nous retenons les résultats issus des entretiens. A titre illustratif, nous relevons deux postures caractérisées par des tensions différentes entre l'approche transmissive d'une part et l'approche transformatrice-critique d'autre part.

CADRE CONCEPTUEL ET GRILLE D'ANALYSE

Il y a une vingtaine d'années Robert Stevenson a identifié des contradictions entre la structure et les intentions de l'école publique d'une part et les objectifs de l'éducation relative à l'environnement (ERE) critique d'autre part. Le chapitre d'ouvrage dans lequel il formule sa thèse du « rethoric-reality gap » a été republié récemment dans une revue scientifique, ce qui témoigne de la persistance de ces contradictions à l'heure actuelle (Stevenson, 2013). Sur le plan institutionnel, l'EDD est souvent proposée comme solution aux limites de l'ERE. Or, on observe des interprétations très différentes des textes onusiens selon les pays, traduisant des pratiques et philosophies sous-jacentes variées (Girault, Zwang & Jeziorski, 2013). L'analyse des écrits scientifiques dans le domaine de l'EDD montre que cette dernière peut être située entre deux pôles : celui d'une éducation positiviste-utilitariste et celui d'une éducation socioconstructiviste critique (Barth &

Michelsen, 2012 ; Girault & Sauvé, 2008 ; Simonneaux & Tutiaux-Guillon, 2012). D'un côté, l'EDD est instrumentalisée afin de répondre à certaines finalités politiques. Il s'agit d'une perspective éducative positiviste. Celle-ci est par ailleurs souvent attachée à une posture utilitariste. « Dans ce cas, le savoir prend son sens par les actions qu'il permet de réaliser ; la dimension opérationnelle est primordiale ; la valeur des savoirs repose sur le pouvoir d'agir sur le réel » (ibid., p. 6). D'un autre côté, l'éducation est considérée comme une construction sociale chargée de valeurs, du poids de l'histoire et de modèles de relations de pouvoir. La visée éducative consiste ici à privilégier la formation des citoyens et la pensée critique. Cette posture est souvent proposée dans le cadre des QSV (Legardez & Simonneaux, 2011). Ces deux pôles sont des extrémités entre lesquelles différentes configurations éducatives sont possibles.

Dans le même sens, Jickling et Wals (2008, 2013) proposent un modèle permettant de situer des approches éducatives en éducation au développement durable entre deux pôles : celui de l'éducation transmissive et celui de l'éducation transformatrice-critique. Selon ces auteurs, la posture face à l'EDD que prennent les praticiens et théoriciens dépend de leurs conceptions de l'éducation et des personnes éduquées. L'éducation transmissive vise à transmettre de façon unilatérale des idées définies par un nombre réduit d'experts externes. Dans la perspective d'efficience et de reproduction sociale, les citoyens sont éduqués au conformisme, autrement dit à accepter leur rôle dans la société du travail. Ils prennent leur place dans des structures hiérarchisées et autoritaires. A l'opposé se trouve l'éducation transformatrice-critique selon laquelle le savoir est co-construit dans un contexte donné. L'objectif est ici d'éduquer des citoyens critiques étant capables de questionner le monde actuel et de créer leur propre monde. L'apprenant est ainsi considéré comme un participant actif de la société, engagé vers des changements sociétaux. Pour illustrer les différentes manières de s'engager dans l'EDD en fonction de la représentation de l'éducation d'une part et du citoyen éduqué d'autre part, ces auteurs proposent le schéma ci-dessous (Figure 1).

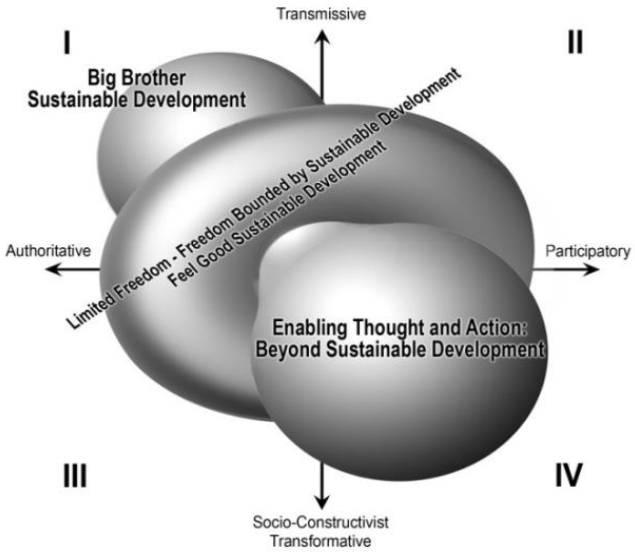

Figure 1. Positioning sustainable development in education within two force fields (Jickling & Wals, 2008).

L'axe vertical représente les conceptions de l'éducation et l'axe horizontal celles des personnes éduquées. Faisant référence à la métaphore orwelienne de l'État - Big Brother, toujours présent et tout-puissant, Jickling et Wals (2008, 2013) critiquent l'approche de l'éducation transmissive au conformisme (Quadrant 1) en proposant le terme « Big-Brother sustainable development ». Dans cette optique, l'éducation sert d'instrument pour réaliser le projet du développement durable, développé et déclaré par les « autorités » comme le « bon » chemin à suivre. Même si les quadrants 2 et 3 se différencient par rapport à certaines caractéristiques, on y trouve finalement des traits communs. Le deuxième quadrant contient des approches participatives, mais celles-ci restent enfermées dans un certain espace idéologique (celui du développement durable) et tendent donc vers une éducation transmissive. Dans le troisième quadrant, les approches transformatrices sont modérées par des méthodes d'enseignement autoritaires. Dans la mesure où les approches participatives et transformatives incluent les possibilités d'élargir l'espace de l'éducation au développement durable, les tendances transmissives et conformistes limitent ces possibilités. Ainsi, selon Jickling et Wals (2008, 2013), ces deux quadrants proposent en quelque sorte la posture de « feel good sustainable development », dans le sens où les apprenants ont l'impression de pouvoir agir librement, mais en réalité, ce sont les autorités qui gardent le contrôle. Dans cette optique, cette posture peut être aussi qualifiée de « liberté limitée par le développement durable » (« freedom bounded by sunstainable development »). Enfin, les approches éducatives situées dans le quatrième quadrant permettent de développer les capacités d'action allant au-delà du développement durable. Ici, la liberté n'est pas limitée. Les approches participatives et critiques sont employées dans le but de former des citoyens capables de faire leurs propres choix.

Dans cet article, nous souhaitons situer les postures de futurs enseignants du secondaire dans le schéma proposé par Jickling et Wals (2008) et de discuter les résultats en termes d'appuis et obstacles à une EDD transformatrice-critique, posture que nous adoptons dans le cadre de la présente recherche. Pour préciser les caractéristiques de cette posture nous nous appuyons sur le courant de la didactique des questions socialement vives (QSV) (Simonneaux & Legardez, 2010) et sur des principes de pédagogie critique s'inspirant notamment des écrits de Giroux (1983) et de McLaren (2007). La notion de développement durable faisant toujours l'objet d'une multitude de définitions et d'une vive controverse (Gough, 2013), son traitement didactique sous l'angle de l'enseignement des QSV requiert ainsi une mise en débat, l'intégration des doutes et de la pluralité des interprétations. La pédagogie critique renforce ce positionnement, visant notamment à munir les élèves des capacités à questionner la réalité et ce dans un but de transformation sociale collective. Dans cette optique, l'éducation devrait engager les apprenants dans la prise de conscience des enjeux de pouvoir et des influences idéologiques qui orientent nos manières de voir le monde et notre rapport à l'environnement (Bader & Sauvé, 2011). Selon Giroux (1983), l'éducation ne doit donc pas transmettre des savoirs et des idées prédéfinies, sous prétexte d'être un espace neutre distribuant des savoirs vrais et validés. Elle doit plutôt être le reflet de notre société (sans la légitimer automatiquement) en tant que lieu de contradiction et de diversité, des cultures et des positionnements distincts, mais dans un esprit du dialogue et de compréhension mutuelle. Accorder à l'école et à l'université une autonomie relative, les voir comme des lieux de contradiction, de négociation et de résistance et non simplement de reproduction des relations dominantes, permet de

garder l'espoir d'un changement social et d'éduquer les citoyens dans cette vision transformatrice et non-fataliste, – qui semble particulièrement important dans une société marquée par de nombreuses crises. Dans cette perspective critique, cette recherche n'a pas pour objectif de contribuer à la formation des enseignants à l'éducation a priori « pour » le développement durable, mais à la formation des enseignants « à propos » du phénomène « développement durable », cela « en adoptant le recul critique nécessaire pour remettre en perspective le sens, les fondements et les visées de ce projet planétaire » (Sauvé, 2006, p. 9).

Ainsi, il s'avère pertinent en premier lieu d'interroger les futurs enseignants sur leurs manières de voir l'éducation au développement durable dans leur futur métier afin d'en tenir compte dans les situations de formation. Dans ce qui suit, nous présentons le dispositif méthodologique mis en place pour étudier les postures de futurs enseignants au regard de l'EDD.

METHODOLOGIE : POPULATION, OUTILS DE RECUEIL ET D'ANALYSE DE DONNEES

Nous avons privilégié une approche qualitative exploratoire pour documenter les postures de futurs enseignants au regard de l'EDD. L'échantillon de départ comporte 223 futurs enseignants ayant participé à une recherche plus large. D'abord, ils ont répondu à un questionnaire. Par la suite, 12 enseignants ont participé à des entretiens semi-directifs. Il s'agit des étudiants québécois en deuxième et troisième année 1) du baccalauréat en enseignement secondaire (BES) – sciences et technologie et 2) d'étudiants du BES – univers social, ainsi que des étudiants français en Master 1 et en Master 2 préparant les concours du certificat d'aptitude au professorat de l'enseignement du second degré (CAPES) de sciences de la vie et de la Terre et d'histoire-géographie. Ces étudiants suivent une formation initiale universitaire. Dans ce cadre, ils participent à des cours théoriques et pratiques sur les disciplines qu'ils auront à enseigner aux élèves et sur les questions de didactique et de pédagogie. Dans les deux contextes nationaux, il s'agit des disciplines les plus touchées par la mise en place de l'EDD, même si les degrés d'implémentation sont différents (Jeziorski, 2013). Pour les fins de cette contribution, les résultats issus des entretiens ont été retenus. Les 12 entretiens ont été enregistrés et retranscrits intégralement.

Dans un premier temps, les données issues des entretiens ont fait l'objet d'une analyse thématique de contenu (Bardin, 1977) permettant de mettre en évidence des éléments dominants chez l'ensemble des 12 futurs enseignants interrogés. Il ne s'agit pas ici de faire une analyse comparative au regard des quatre groupes de futurs enseignants, mais plutôt de dégager l'éventail de possibles positionnements face aux différents enjeux socio-didactiques afin de les analyser par la suite en termes d'appuis et d'obstacles à une EDD transformatrice-critique sous l'angle des QSV. Lors de l'entretien les futurs enseignants ont été invités à s'exprimer sur le thème « développement durable » d'une part et sur le thème « éducation au développement durable » d'autre part. Nous présenterons ici les résultats en lien avec le second thème. Lors de l'étape de thématisation du corpus, les données ont été classées selon plusieurs sous-thèmes

définis dans le canevas d'entretien. A titre illustratif, nous présentons les résultats en lien avec trois sous-thèmes : finalités de l'EDD, difficultés liées à l'EDD et enseignement des controverses. Pour chacun des sous-thèmes, plusieurs catégories émergent de l'analyse thématique.

Dans un deuxième temps, nous avons réalisé une étude verticale des entretiens afin de cerner les postures des futurs enseignants sur le plan individuel. Pour cela, nous avons procédé à un second examen de chaque entretien dans le but d'identifier la coexistence des catégories ayant émergées lors de l'analyse transversale au niveau individuel et de documenter l'articulation entre ces différentes catégories.

ANALYSE ET DISCUSSION DES PRINCIPAUX RESULTATS

RESULTATS ISSUS DE L'ANALYSE THEMATIQUE TRANSVERSALE

D'abord, nous présentons les principaux résultats issus de l'analyse thématique transversale. Plus précisément, nous documentons la manière dont les futurs enseignants interrogés décrivent les finalités de l'EDD, les difficultés liées à l'EDD et l'enseignement des controverses associé au DD.

Finalités de l'EDD

Le sous-thème finalités de l'EDD est abordé par des futurs enseignants de manière importante. En effet, il a fait l'objet de leurs discours dans 52 énoncés au total, regroupés dans cinq catégories ayant émergées lors de l'analyse.

Faire comprendre – La catégorie « faire comprendre » renvoie à une approche transmissive de l'éducation. C'est l'explication et la transmission des connaissances prédéterminées, souvent dans le but de favoriser l'action dans un sens prédéterminé (celui du DD), qui est mise de l'avant. Cette finalité de l'EDD est considérée comme importante par la majorité des futurs enseignants. 9 personnes s'expriment à 15 reprises à ce sujet. Voici un extrait d'entretien à ce propos :

> Dans le fond, c'est transmettre nos connaissances. Puis, comme ça, de génération en génération, ils vont savoir qu'il faut se soucier de l'environnement dans lequel on est, mais il faut se soucier aussi de l'économie. (…) Je pense que c'est plus ça, c'est transmettre nos savoirs d'une génération à l'autre.

Faire agir – Il s'agit, dans cette catégorie, des idées renvoyant à une approche comportementaliste et autoritaire de l'EDD, déjà mentionnée dans la catégorie précédente. Dans ce sens, l'EDD aurait pour finalité de changer les comportements des élèves dans le sens du développement durable. 7 futurs enseignants mentionnent cette idée à 15 reprises. Elle semble donc être importante. Voici un exemple : "Et la finalité (de l'EDD), c'est de changer les modes de consommation, le comportement de consommation, et aussi le comportement social"

Faire réfléchir et developer l'esprit critique – La moitié des futurs enseignants interrogés (10 énoncés) pensent cependant que la finalité de l'EDD serait de faire réfléchir les élèves et de développer leur esprit critique afin de pouvoir prendre des décisions citoyennes éclairées. Voici un extrait qui illustrent bien cette façon de voir l'EDD :

> Je crois que l'éducation à la citoyenneté – ça va ensemble avec l'EDD – prépare le citoyen à évoluer et à participer dans la société où il est présent ou où il sera présent, car il est mobile dans l'espace. Oui, c'est ça, c'est de préparer le citoyen à faire les bons choix, pas les choix qui sont nécessairement dictés par la personne qui est en face de lui, donc l'enseignant. Il faut lui donner les outils pour qu'il développe l'esprit critique. Voilà, donc de le doter de l'esprit critique pour qu'il fasse ses choix et en espérant que ce soient des bons choix.

Faire prendre conscience – Une autre catégorie se réfère à l'idée de faire prendre conscience aux élèves de l'importance du développement durable de manière générale et de l'impact de l'homme sur l'environnement en particulier. 5 futurs enseignants citent cette finalité de l'EDD à 7 reprises. L'exemple suivant illustre cette idée :

> Que les citoyens sont plus responsables, qu'ils sont plus conscients de c'est quoi le développement durable. Puis les défis qui attendent le développement. C'est vraiment de faire comprendre aux élèves, c'est une compréhension profonde, qu'ils comprennent l'importance.

Montrer – La catégorie renvoyant à la finalité consistant à montrer – la plupart de temps - la nécessité d'un développement durable, et par conséquent la nécessité d'agir dans ce sens, est proche de celle de faire comprendre et de faire prendre conscience et comprend souvent ces deux dernières finalités. Elle s'inscrit également dans une approche transmissive et parfois utilitariste. Elle n'explicite pas un travail d'appropriation des apprentissages par l'élève. L'expression montrer met en effet l'accent sur le rôle actif de l'enseignant en négligeant l'activité de l'élève. En tous cas, cette dernière n'est pas explicitée. 5 futurs enseignants s'expriment dans ce sens. Voici un exemple : "Puis, venir donner aux élèves des exemples de ce qu'ils pourraient faire pour améliorer le développement durable."

Difficultés liées à l'EDD

De nombreuses difficultés seraient liées à l'EDD selon les futurs enseignants interrogés. Celles-ci ont été regroupées en 8 catégories évoquées par un nombre de sujets plus ou moins important. 49 énoncés sont en lien avec ce sous-thème. Parmi les difficultées les plus importantes figurent le manque de temps, le manque d'une définition claire et unique du développement durable et les difficultées liées à la mise en place d'actions éducatives tenant compte de l'interdisciplinarité et de la complexité du développement durable. Considérant l'interdiscipliarité comme une caractéristique d'éducation transformatrice-critique sous l'angle des QSV, il nous semble pertinent de préciser les difficultés mentionnées par les personnes interrogées à ce propos.

Difficulté liée à l'interdisciplinarité et à la complexité du DD – De manière générale, les futurs enseignants reconnaissent la complexité et le caractère interdisciplinaire du développement durable, mais la conception d'une action interdisciplinaire en EDD leur semble difficile. 5 enseignants mentionnent cette difficulté à 14 reprises.

La présente recherche pointe en effet de manière fine les difficultés épistémologiques en termes de rapports aux savoirs pour mettre en place ce type d'activités. Outre l'obstacle pratique (manque de temps, problèmes de coordination avec les enseignants d'autres disciplines que la sienne), trois principaux obstacles à l'interdisciplinarité émergent dans les entretiens. Nous les illustrons ici par les extraits d'entretiens de trois futurs enseignants selon lesquels le développement durable est un objet complexe et nécessite une approche interdisciplinaire. Premièrement, pour une future enseignante québécoise de science et technologie, la spécialisation dans les disciplines que l'on veut croiser serait une condition à l'interdisciplinarité :

> Mais vu que malheureusement c'est un prof qui donne chaque matière, c'est très difficile pour le prof de commencer à aller chercher, tu sais il va se promener dans la cours des voisins quand il commence à donner des notions politiques, des notions sociales, alors que c'est juste un prof des sciences. Ou au contraire, le prof d'histoire qui aimerait enseigner le développement durable, il ne se sent peut être pas à l'aise avec les notions scientifiques …On ne peut pas être pro dans les trois facettes.

Un deuxième obstacle concerne l'association épistémologique perçue par les futurs enseignants. En ce sens, certains savoirs disciplinaires seront mieux adaptés que d'autres pour expliquer certains phénomènes, comme l'explique ce futur étudiant québécois en science et technologie :

> …environnement c'est en sciences qu'on va en apprendre davantage. C'est comme ça que je le voie… l'économie…tu vas apprendre dans un autre cours, le social aussi… Si je commencerais à approfondir en économie, puis dans la politique, ben je dévierais de mon sujet qui est la science.

Enfin, le troisième obstacle consisterait en manque d'une définition unique et stabilisée, voire « purement scientifique » du développement durable. Une définition commune partagée par tous les membres enseignants d'une équipe pluridisciplinaire, apparemment nécessaire pour s'engager dans une action interdisciplinaire, semble difficile comme en témoigne l'extrait d'entretien avec un futur enseignant français d'histoire-géographie : "Monter un projet interdisciplinaire sur un thème comme le développement durable, je vais me répéter, mais il va falloir se caler avec le prof de SVT pour avoir la même definition".

Enseignement des controverses

Nécessité de montrer différents points de vue – Tout d'abord, la majorité des futurs enseignants interrogés (9 sujets, 13 énoncés) pensent qu'il est important de montrer aux élèves différents points de vue concernant le développement durable pour qu'ils se fassent leur propre opinion. Un tel raisonnement rejoint ainsi une approche transformatrice-critique de l'EDD :

> Moi, je trouve ça pertinent de le dire que c'est controversé et de dire pourquoi c'est controversé, et c'est quoi le pour, c'est quoi le contre de tout ça. Je trouve ça super bien, parce que il faut faire apprendre aux élèves que dans la vie ne pas tout est comme ça. Il y a plusieurs aspects qui sont importants sur une chose, dont sur le développement durable, il y a plusieurs aspects.

Risque de prendre position, nécessité de garder une posture neutre – Cependnat, 7 des 12 futurs enseignants soulignent que dans le cadre de l'EDD, le risque de prendre position au regard de l'objet de l'enseignement est grand. Or : "l'enseignant est supposé d'être neutre. "

Obligation de suivre le programme politique et scolaire – Malgré l'importance d'enseigner les controverses exprimées par la majorité des 12 futurs enseignants, la moitié de ceux-ci (13 énoncés) mentionne l'obligation de suivre le programme politique et scolaire, considérant ainsi le développement durable comme une prescription, alors qu'il pourrait être envisagé comme une proposition. C'est ainsi qu'on observe une tension entre le souci de tendre vers l'objectivité et de développer l'esprit critique des élèves d'une part et d'enseigner dans le sens du développement durable, – c'est-à-dire de transmettre des idées préconçues –, d'autre part. Voici un extrait qui illustre bien ce raisonnement paradoxal :

> Et je pense qu'en géographie, on ne nous le permettrait pas, je ne pense pas qu'on nous le permettrait vraiment, un bon fonctionnaire éthique et responsable de remettre en cause une notion clé du programme. Après, je fais la part des choses entre mes convictions et ce que je peux penser du développement durable. J'ai un discours un peu plus officiel qu'il faut quand même que je tienne dans mes cours.

L'analyse thématique transversale des résultats issus des parties des entretiens centrées sur le thème de l'éducation au développement durable montre que cette « éducation à », telle qu'elle est envisagée par les futurs enseignants interrogés, peut prendre forme d'une éducation transmissive et/ou transformatrice-critique. En effet, alors que les catégories associées aux finalités de l'EDD faire comprendre, faire agir, faire prendre conscience, montrer renvoient à une approche transmissive de l'EDD, faire réfléchir et développer l'esprit critique est caractéristique de la perspective transformatrice-critique. Dans cette optique, les douze futurs enseignants des quatre sous-groupes mentionnent majoritairement la posture transmissive en lien avec l'EDD (42 de 52 énoncés). Toutes ces finalités (faire comprendre, faire agir, faire prendre conscience et montrer) ne sont pas en soi des indicateurs d'une éducation exclusivement transmissive. Faire comprendre le fonctionnement planétaire et faire prendre conscience des enjeux environnementaux et sociaux, par exemple, est en effet très louable et nécessaire afin de pouvoir prendre des décisions éclairées. Or, le relativement faible recul critique face à l'injonction du développement durable dans les propos des futurs enseignants indique tout de même une forte tendance vers une approche transmissive. La finalité de l'EDD consistant à faire réfléchir les élèves et de développer leur esprit critique afin qu'ils puissent prendre des décisions citoyennes de manière argumentée, est évoquée par six futurs enseignants à dix reprises. Même si cette approche critique-transformatrice est mentionnée de manière minoritaire, il est notable qu'elle cohabite toujours avec les autres catégories renvoyant à l'approche transmissive. Il semble ainsi y avoir une tension entre l'approche transmissive de l'EDD d'une part et l'approche transformatrice-critique d'autre part dans les propos des futurs enseignants interrogés. L'analyse des résultats issus des entretiens concernant le sous-thème "enseigner les controversies" permet d'affiner ce propos. Quand on demande aux futurs enseignants s'ils envisagent d'enseigner les controverses liées au développement durable, il apparait une tension dans les réponses entre la nécessité de montrer aux élèves différents points de vue concernant le développement durable pour que les élèves se fassent leur propre opinion (un tel raisonnement rejoint ainsi une approche transformatrice-critique de l'EDD) d'une part, et l'obligation de suivre le programme politique et scolaire, d'autre part.

L'ANALYSE VERTICALE (INTRA-INDIVIDUELLE) : FOCUS SUR DEUX TENSIONS

L'analyse intra-individuelle des données issues des entretiens a permis de renforcer et d'affiner l'hypothèse de la coexistence de la posture transmissive d'une part et transformatrice-critique d'autre part, repérée lors de l'analyse transversale des

entretiens. Celle-ci s'exprime chez les futurs enseignants sous forme de tensions qui les empêchent finalement de s'engager dans une EDD comme ils le souhaitent. Dans ce qui suit, nous proposons d'illustrer deux champs de tensions intra-individuelles se rapportant aux questions d'enseignement de controverses et de finalités et de les situer dans le schéma proposées par Jickling et Wals (2008).

Enseignement des controverses : neutralité, posture critique ou partialité tacite sous prétexte de neutralité

L'exemple d'un futur enseignant québécois en univers social illustre la tension entre l'existence d'une posture critique au regard de la notion du développement durable d'une part et la nécessité de garder une posture neutre face aux élèves d'autre part. En effet, cet étudiant a un regard critique sur la proposition du modèle sociétal "développement durable" :

> …j'ai la difficulté avec certains points comme je l'ai dit, à les accepter. Personnellement, si je penserai juste à moi, je ne l'accepterai pas, parce que, comment dire, je trouve que ça ne sert pas tant que ça. On ne se rend pas compte directement des efforts qu'on fait. On ne se rend pas compte des conséquences tout de suite de nos actes… je suis contre le fait qu'on m'impose ces mesures-là, parce que je ne les trouve pas adaptées à, je trouve qu'elles contreviennent à ma liberté personnelle.

Cependant selon cet étudiant, son point de vue n'a pas de place en classe, car :

> ...un des principaux risques de cette éducation-là [EDD] est que je teinte mon éducation… Je n'ai pas le droit. Dans mes cours, on apprend, dans mes stages on ne peut pas teinter. Ça n'apporte rien aux élèves de donner mon point de vue.

Le même étudiant poursuit en soulignant l'obligation de suivre le programme politique et scolaire, considérant ainsi le développement durable comme une prescription :

> Oui, le ministère de l'éducation a quand même mis en place un programme que je dois suivre. Si je ne le suis pas, je contreviendrai à mes devoirs professionnels… Ben c'est sûr qu'en tant qu'enseignant je n'aurai pas le choix d'inculquer cette philosophie là parce que c'est là où la société a voulu s'en aller.

Enfin, en tant que futur enseignant, il finit par prendre une posture fataliste : « Je crois qu'on n'a pas le choix de l'accepter [le développement durable] ».

Le développement durable comme objet est donc ici considéré comme une construction sociale, créée par la société et critiquable en soi. Cette posture peut être un appui à une éducation transformatrice-critique. Cependant la nécessité de garder une posture neutre et l'obligation de suivre le programme constituent des obstacles à ce type d'éducation. D'autant plus que la revendication de neutralité semble être en contradiction avec la nature même de la notion de « développement durable » qui n'est pas neutre, et avec l'obligation de suivre le programme scolaire. Envisagé sous l'angle de la pédagogie critique, le programme scolaire est une construction sociale (et donc aussi politique) -, et est en effet loin d'être neutre. On observe donc un effet pervers de ce souci de neutralité des futurs enseignants dans la mesure où le suivi inconditionnel du programme scolaire - sous prétexte de neutralité -, doit être considéré plutôt comme un acte politique et une prise de position plus ou moins inconsciente, d'autant plus que l'acte d'enseignement est influencé par les représentations sociales des enseignants véhiculant un certain système de valeurs qui ne sont pas neutres non plus (Jeziorski, 2013). En référence à la typologie de postures face à l'enseignement des controverses proposée par Kelly (1986), l'impartialité apparemment neutre (ibid.) prend ainsi forme de ce qu'on pourrait appeler une partialité tacite, probablement inconsciente, sous prétexte de neutralité.

Nous proposons de situer cette tension entre la posture de partialité tacite sous prétexte de neutralité et l'existence d'une posture critique face au DD dans le troisième cadrant du schéma de Jickling et Wals. Alors que la première posture peut être considérée comme un indicateur d'une éducation au conformisme, la deuxième pourrait permettre de tendre vers une éducation transformatrice-critique. En effet, une prise de position au regard d'une culture dominante (McLaren, 2007) parait être une nécessité préalable à une transformation sociétale.

Finalités de l'EDD : entre faire adhérer au DD et faire réfléchir

La deuxième tension intra-individuelle concerne les finalités de l'EDD. Dans ce qui suit, celle-ci sera illustrée par l'exemple d'une future enseignante française de SVT. Pour elle, l'EDD aurait d'un côté pour objectif de faire agir les élèves dans le sens du DD, de faire comprendre la nécessité du DD et de faire prendre conscience de son importance :

> Après, je pense à ça, amener les enfants ramasser les déchets sur la plage. Quand ils sont petits, ils vont comprendre, qu'il ne faut pas jeter, parce que c'est sale, parce que ça pollue, même si pour eux, polluer ça va être très vague. Mais on peut aussi leur dire que les sacs plastiques dans la mer, les petits aiment beaucoup ça, ça va être mauvais pour les tortues. Donc, rien que ça, pour moi, ça fait partie du développement durable.

D'un autre côté, la même future enseignante pense qu'en EDD, il s'agit de faire réfléchir les élèves et de leur permettre de faire leurs propres choix qui ne sont pas dictés par l'enseignant :

> Et c'est les faire réfléchir, leur donner peut-être un peu plus d'outils pour qu'ils prennent un peu moins pour acquis certaines choses, certains biens matériels, mettre peut-être un peu plus en question, est-ce que j'ai vraiment besoin de ça ? Est-ce que je vais plutôt choisir tel produit ou tel autre ? Voilà, qu'ils aient la réflexion, les outils pour se poser des questions et donc avoir à ce moment-là une implication un peu plus active…

Cette liberté de choix reste cependant limitée, car pour cette étudiante, la réflexion devrait permettre "une implication un peu plus active dans le développement durable".

A l'instar de la première tension, nous proposons de situer cette deuxième dans le troisième quadrant. « Faire réfléchir et donner des outils afin de faire ses propres choix » correspondrait ainsi à un objectif d'apprentissage allant dans le sens de l'approche transformatrice relevant du socioconstructivisme. Dans une perspective de formation des enseignants, il serait important de se servir de ce positionnement comme appui à une EDD critique en travaillant avec les futurs enseignants sur les compétences nécessaires permettant la mise en situation. Par contre, « faire adhérer les élèves à l'idée du développement durable », correspondrait à l'objectif d'une éducation visant à se conformer aux normes et aux valeurs imposées. La nécessité de recycler, d'économiser l'énergie, de réduire la consommation sont ainsi considérées comme des comportements indispensables et par conséquent indiscutables alors qu'ils pourraient être soumis au débat. Le manque de problématisation en EDD (et en ERE) et le recours à une éducation par « petits gestes verts » ont été observés dans d'autres recherches menées dans différents pays, par exemple avec des enseignants italiens (Floro, 2011), français (Pommier & Boyer, 2005) ou encore avec des enseignants en formation au Royaume-Uni (Summers et al, 2004, 2005). Or, comme le soulignent Tan et Pedretti (2010) dans leur étude avec des enseignants canadiens d'Ontario, il semble que cette posture transmissive relève davantage de l'endoctrinement que de l'éducation. Se référant à Green (1964), ces auteurs précisent que l'endoctrinement est un processus de changement de croyances et d'idées des individus sans faire le détour par le processus de réflexion rationnelle avant l'adhésion.

CONCLUSION

La présente étude a montré que les futurs enseignants interrogés prennent une posture face à l'EDD qui oscille véritablement entre l'approche transmissive d'un côté et transformatrice-critique d'un autre côté. La mise en lumière des postures et tensions en EDD permet de formuler l'hypothèse de l'existence de la posture « de liberté limitée » chez les sujets interrogés (Jickling & Wals, 2008, 2013). L'importance des activités

réflexives et interdisciplinaires autour du développement durable et l'emploi des débats sont exprimés, mais leur réalisation semble se heurter au paradigme positiviste de l'école, encore dominant. De plus, alors que l'approche transformatrice-critique devrait laisser la liberté aux apprenants de faire leurs propres choix quant à la perception et construction de la société, la plupart de temps cette liberté est délimitée par la transmission de l'idée du développement durable tel qu'il est perçu par les futurs enseignants et par des valeurs sous-jacentes. Il semble qu'à l'heure actuelle l'EDD se heurte à des difficultés majeures, dont une grande partie a déjà été repérée dans le cas de l'ERE (Grunenwald, 2004).

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PROPOSITIONS POUR UNE MODELISATION DES PROCESSUS DE DIDACTISATION SUR DES QUESTIONS SOCIALEMENT VIVES

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RESUME

L'objectif de cette contribution est d'avancer dans la caractérisation et la structuration du domaine de recherches sur les Questions Socialement Vives (QSV) – ou Socially Acute Questions (SAQ) –, en revisitant des propositions faites dans la période d'émergence de cette thématique. Il s'agit donc de proposer une nouvelle présentation de travaux de chercheurs du champ, en termes de processus de didactisation de QSV, ainsi que dans une perspective transformatrice. Cette analyse se fait en relation avec notre grille d'analyse des rapports aux savoirs dans l'enseignement et la formation (Legardez, 2004), désormais revisitée dans une perspective de didactique de questions « hyper-vives » – liées notamment à l'écocitoyenneté – à visée transformatrice-critique (Legardez & Jeziorki, 2017) -. L'objectif de nos travaux est aussi d'éclairer la réflexion et les pratiques des acteurs de l'enseignement et de la formation, dans une perspective d'émancipation et de transformation.

MOTS CLES

Questions Socialement Vives , Didactisation , Rapports aux savoirs et aux valeurs , Perspective transformatrice-critique.

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PROPOSALS FOR A MODELING OF THE DIDACTIC PROCESSES ON SOCIALLY ACUTE QUESTIONS

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ABSTRACT

The objective of this contribution is to advance the characterization and structuring of the Socially Acute Questions (SAQ) research field, by revisiting proposals made in the period of emergence of this theme. It is therefore a question of proposing a new presentation of works of researchers of the field, in terms of SAQ didactic process, as well as from a transformative perspective. This analysis is carried out in relation to our grid of analysis of relations to knowledge in education and training (Legardez, 2004), now revisited from a perspective of didactics of "hyper-acute" questions—linked in particular to eco-citizenship—with a transformative-critical aim (Legardez & Jeziorki, 2017). The objective of our work remains to contribute also to clarify the reflection and the practices of the actors of education and training, with a perspective of emancipation and transformation.

KEY WORDS

Socially acute questions, Didactization, Relations on knowledge and values, Transformative-critical perspective.

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PROPOSTAS PARA A MODELIZAÇÃO DOS PROCESSOS DIDÁTICOS SOBRE AS QUESTÕES SOCIALMENTE VIVAS

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RESUMO

O objetivo desta contribuição é avançar a caracterização e a estruturação do domínio das descobertas científicas sobre as Questões Socialmente Vivas (QSV) – ou Socially Acute Questions (SAQ) –, revisitando as proposições feitas no período da emergência desta temática. Trata-se, portanto, de propor uma nova apresentação de trabalhos de investigadores deste campo em termos da didática do processo de QSV, assim como numa perspetiva transformadora. Esta análise é feita em relação com a nossa grelha de análise das relações com o conhecimento na educação e formação (Legardez, 2004), agora revisada a partir de uma perspetiva da didática das questões "hiper-vivas" – ligadas em particular à eco-cidadania – com um objetivo crítico-transformador (Legardez & Jeziorki, 2017). O objetivo do nosso trabalho é também clarificar a reflexão e as práticas dos atores da educação e formação, numa perspetiva de emancipação e transformação.

PALAVRAS-CHAVE

Questões Socialmente Vivas, Didática, Relações sobre conhecimento e valores, Perspetiva crítico-transformadora.

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Propositions Pour une Modélisation des Processsus de Didactisation sur des Questions Socialement Vives

Alain Legardez

INTRODUCTION

Cette contribution s'inscrit dans le cadre des perspectives ouvertes par la communication au premier Symposium du GRID-QSV en 2014 à Toulouse (Legardez & Jeziorski, 2014) et par les débats qu'elle a pu susciter. Certaines questions ombilicales et récurrentes des QSV avaient été évoquées et une proposition de typologie des travaux sur les QSV en termes de processus de didactisation avait été ébauchée. Il s'agissait également d'inciter à approfondir les grilles d'analyses théoriques des questions d'enseignement et de formation socialement vives. Ces discussions ont été prolongées lors du deuxième Symposium du GRID-QSV en 2015 à Lisbonne et du troisième en 2016 à Londres.

L'objectif de cette nouvelle contribution est de reprendre et de prolonger cette tentative de structuration et de modélisation, souvent en revisitant des propositions faites dans la période d'émergence du domaine de recherches sur les QSV définies par Legardez et Simonneaux (2006, pp. 21-22, 2011, pp. 16-17) :

Une question triplement socialement vive est une question qui prend (ou qui est amenée à prendre) forme scolaire[1] et qui possède les caractéristiques suivantes :

- Elle est vive dans la société : une telle question interpelle les pratiques sociales des acteurs […] et renvoie à leurs représentations sociales ; elle est considérée comme un enjeu par la société […] et suscite des débats […] Sa production sociale la rend donc « vive » dans un premier sens.
- Elle est vive dans les savoirs de référence : elle suscite des débats (des controverses) entre les spécialistes de champs disciplinaires ou entre experts de champs professionnels. […]Sa production sociale dans les milieux scientifiques ou professionnels, dans les mouvements sociaux, politiques et culturels, la rend donc « vive » dans un deuxième sens.
- Elle est vive dans les savoirs scolaires : la question est alors d'autant plus « potentiellement vive » au niveau des savoirs scolaires qu'elle renvoie à une double vivacité dans les deux autres niveaux de savoirs.

Ce travail s'intéresse aussi aux objectifs des recherches sur des QSV dans la perspective de transformation de la société, comme le précisaient déjà les organisateurs du premier symposium (Simonneaux, Simonneaux & Legardez, 2014, p. 4) :

1 «Forme scolaire » ou de tous les autres types de formations : formelles, non formelles, informelles.

> La didactique des QSV n'est donc pas seulement une didactique sur des objets spécifiques, c'est une didactique qui s'appuie sur une socio-épistémologie dépassant le simple cadre scolaire et c'est une didactique engagée dans une visée transformative.

Nous proposons donc de présenter et discuter un projet de grille de lecture des travaux sur les QSV, puis d'esquisser une modélisation du processus de didactisation.

VERS UNE GRILLE DE LECTURE DES RECHERCHES SUR DES QSV

Néanmoins, ces mêmes auteurs ajoutaient (Simonneaux, Simonneaux & Legardez, 2014, p. 4) :

> Cette visée transformative de la recherche peut certes prendre différentes formes – éducation critique, sociopolitique, activisme – et utiliser différents leviers, des ingénieries expérimentales ou ordinaires, et être plus ou moins implicites.

Il y a donc différentes manières d'étudier l'enseignement et l'apprentissage de QSV, tout en restant dans une perspective globale d'ordre didactique. L'objectif sera de tenter de les caractériser de manière structurée, - toujours en termes de processus de didactisation de QSV – la dynamique des recherches sur des QSV, en prenant également en compte l'objectif d'une visée transformatrice. Il serait ainsi relativement plus aisé de chercher à repérer, - pour chaque texte qui se réclame de la thématique des QSV -, son positionnement dans l'étude du processus de didactisation. Pour ce faire, nous repartirons d'une définition révisée de l'étude de QSV dans une perspective didactique.

LES ETAPES DE L'ETUDE DE QSV DANS UNE PERSPECTIVE DIDACTIQUE

Partant de notre contribution de Toulouse (Legardez & Jeziorski, 2014, pp. 25-27), nous proposons une nouvelle version des étapes de l'étude d'une QSV dans une perspective didactique.

Une structuration raisonnée[2] est proposée pour les études de QSV[3], selon un axe qui va de la plus grande généralité (sociale) à la plus forte spécificité (didactique) et au regard des genres de savoirs (Chevallard, 1991). Ces études seront alors caractérisées selon leur « étape dans le processus de didactisation » et en fonction de leurs rapports

2 Cette grille d'analyse se présente donc comme une « structuration raisonnée » et non plus comme une « typologie » qui aurait pu sous-entendre une ambition normalisatrice et masquer ainsi la dynamique des recherches sur des QSV.

3 Ces étapes sont regroupées dans un tableau récapitulatif (cf Tableau 1, infra).

aux différents savoirs ; quatre étapes de didactisation seront alors distinguées. Des informations seront ajoutées sur les objectifs affichés de l'étude de la QSV concernée - en termes d'engagement -, selon un gradient qui va de la neutralité au militantisme.

L'étude de QSV sous l'angle généraliste est la plus éloignée de l'étape de la didactisation ; ce sont souvent de grandes questions de société, récurrentes et imposées par l'actualité. L'étude de ces savoirs sociaux (SSoc) peut alors se faire au regard des opinions, des conceptions, des représentations sociales ou des systèmes de représentations-connaissances des apprenants, voire des autres acteurs de la formation de manière à relever des informations sur leurs savoirs préalables à un éventuel processus d'enseignement-apprentissage.

L'étude de QSV sous l'angle scientifique cherche souvent à rendre ces questions scientifiques potentiellement didactisables. Il s'agit de l'étude des savoirs et discours à vocation scientifique (SSci) sur des questions de société – souvent controversés - qui jouent un rôle de savoirs de référence (SRef) pour des QSV. Cette étape peut aussi être effectuée (en tout ou partie) par une étude d'autres savoirs de références, comme des savoirs et pratiques professionnelles : par exemple pour l'étude d'objets scolaires des enseignements professionnels (Lebatteux, 2006) ou encore des savoirs locaux (Floro, Jeziorski & Legardez, 2015).

L'étude de QSV sous l'angle de l'éducation et de la formation examine ces questions potentiellement en voie de didactisation. Il s'agit alors d'études sur des objets d'enseignement et de formation, particulièrement sur leur mise en forme scolaire dans des curricula (Lange, 2014).

L'étude de QSV sous l'angle spécifique des processus d'enseignement-apprentissage en situation didactique porte sur des objets d'enseignement et de formations, liés à des questions sensibles et controversées et qui sont étudiés jusqu'à la mise en œuvre dans la situation didactique. Ces études correspondent donc à la définition initiale des QSV. Des exemples sont proposés notamment dans les deux ouvrages collectifs sur les QSV (Legardez & Simonneaux, 2006, 2011), ainsi que dans la Revue Francophone du développement durable (2014-4) consacrée aux QSV et qui fait suite au symposium de Toulouse[4].

4 C'est dans cette ouvrage que nous prendrons des exemples illustratifs de notre proposition de classification dans le notre tableau 1 ci-dessous.

Résumé des étapes de l'étude des différentes étapes d'études d'une QSV dans une perspective didactique :

E1 : étude des savoirs sociaux (SSoc) : opinions, représentations sociales (RS), système de représentations-connaissances (SRC)
E2 : étude des savoirs de référence (SRef) : savoirs scientifiques (souvent controversés), pratiques sociales ou professionnelles (souvent non stabilisées), éléments de savoirs locaux
E3 : étude des curricula
E4 : étude des situations didactiques

Précisons qu'une QSV peut être étudiée sur l'une, sur plusieurs ou sur l'ensemble des étapes, et dans un ordre qui n'est pas unilinéaire. Par contre, une étude didactique complète d'une QSV prendrait en compte ces différentes étapes et déboucherait sur l'étude de situations didactiques.

EXEMPLE DE STRUCTURATION

Tableau 1
Structuration raisonnée des études sur des QSV

Etapes et types de savoirs ***(en colonnes)***	**Etudes de QSV sous l'angle généraliste**	**Etudes de QSV sous l'angle scientifique**	**Etudes de QSV sous l'angle éducation-formation**	**Etudes de QSV sous l'angle didactique**	***Objectifs de l'étude de QSV dans la perspective transformatrice***
Exemples ***(en lignes)***	***Savoirs sociaux (SSoc)***	***Savoirs de référence scientifiques (SRef-Sci)***	***Savoirs pour l'enseignement et la formation (SEF) - curricula***	***Savoirs didactisés (SDid)***	
(1) Etudes de questions scientifiques controversées et incertitude C. *Marquat, Y. Rafaitin, A. Diemer*	Evoquées dans l'article	Etudiées dans l'article	Evoquées dans l'article	Etudiés dans l'article: carte des controverses et débats	Objectifs: Mener des débats argumentés
(2) Savoirs disciplinaires et RS du DD *A.Berrios*	Etudiées dans l'article: Connaissance des RS par l'étude en contexte scolaire	Non évoquées dans l'article	Non directement étudiées dans l'article: Evocation des curricula	Etudiées dans l'article: Etude des savoirs préalables en contexte scolaire	Objectif: Rechercher les appuis et obstacles dans une perspective critique du DD
(3) Analyse curriculaire sur la question de la production alimentaire et de sa durabilité *J.-M. Lange*	Non directement étudiées dans l'article	Non directement étudiées dans l'article	Etudiées dans l'article: Macro-didactique curriculaire Curricula prescrits Analyse réticulaire	Non directement étudiées dans l'article	Objectifs: «Intérêt épistémologique et éducatif» «éducation citoyenne au choix» «appropriation critique des enjeux»
(4) Cartographier les controverses sur les gaz de schistes *N. Hervé*	Non directement étudiées dans l'article	Non directement étudiées dans l'article	Non directement étudiées dans l'article	Etudiées dans l'article: Carte des controverses	Objectifs: Apprentissages critiques
(5) Prescription, manuels et vivacité de la QSV du bien-être animal *A.Lipp, M.Vidal, L. Simonneaux*	Non évoquées dans l'article	Non directement évoquées dans l'article	Etudiées dans l'article: Curricula prescrits propositionnels Controverses éthiques	Non directement étudiées dans l'article	Objectifs: connaissances positionnements éthiques
(6) Débat sur des QSV liées aux nano-technologies *N. Panissal*	Evoquées dans l'article: Emergences des thématiques liées aux nanotechnologies	Etudiées dans l'article: «Social Ethical Issues» -SEI liées aux nanotechnologies	Pas étudiées dans l'article	Etudiées dans l'article: Problématisation organisation de débat dans la classe Analyse de discours et de rationalités	Objectif de Transformations des savoirs Engagement des élèves dans une rationalité critique pour une «problématisation citoyenne»

(7) Construction de raisonnements sur des QSV *O. Morin,* *N. Cancian,* *A. Sarda,* *L. Simonneaux,* *J. Simonneaux*	Non directement étudiées dans l'article	Non directement étudiées dans l'article	Non directement étudiées dans l'article	Etudiées dans l'article: Interactions sociodiscursives Argumentations individuelles et collectives Analyse des degrés de complexités	Objectifs: «Appropriation participative» Construction d'expertises Prise de décisions d'actions individuelles et collectives
(8) Apprentissage des QSV liées à l'environnement et l'agronomie *L. Simonneaux* *J. Simonneaux*	Etudiées dans l'article: Prise en compte des «savoirs profanes»	Etudiées dans l'article: «hybridation des savoirs» sciences politique	Etudiées dans l'article: Approche éducative des interactions Sciences-Technologies-Société-Environnement (STSE)	Etudiées dans l'article: Stratégies didactiques: doctrinale, problématisante, praxéologique, critique Modèles pédagogiques: positiviste, interventionniste, critique Education scientifique, humaniste, politique	Objectifs: cognitifs, affectifs, axiologiques, pragmatiques Argumentation Questionnement socio-scientifique Réflexion critique Emancipation sociale «QSV = citoyenneté scientifique et politique engagée»
(9) Rapports aux savoirs scientifiques et formes d'engagement citoyens face au changement climatique *B.Bader,* *E.Morin,* *G.Therriault,* *I. Arseneau*	Etudiées dans l'article: Prise en compte des conceptions des élèves	Non directement évoquées dans l'article	Non évoquées dans l'article	Etudiées dans l'article: Ilots de rationalité (Fouriez)	Objectifs: Enseignement des sciences «éducation à l'écocitoyenneté critique et créative» Engagement écocitoyen
(10) Analyse de ressources pédagogiques sur des QSV environnementales *B. France* *S. Birdsal*	Non évoquées dans l'article	Etudiées dans l'article: Approche des sciences environnementales controversées	Etudiées dans l'article: Etude de ressources pédagogiques	Etudiées dans l'article: Contextualisation de questions environnementales Approche didactique de SSI «configurations didactiques»: attributs du savoir Posture épistémologique Stratégies didactiques	Objectifs: Positionnement épistémologique Stratégies pédagogiques Prise de décisions favorables à l'environnement «réfléchir de façon critique et entreprendre des actions»
(11) Discussion de QSV et promotion de l'activisme *E. Linhares,* *P. Reis*	Etudiées dans l'article: Prise en compte des «savoirs du sens commun» Etude des conceptions des futurs enseignants en contexte de formation	Etudiées dans l'article: Etude de «didactique engagée» des QSV scientifiques controversées Prise en compte des conflits de valeurs	Non évoquées dans l'article	Etudiées dans l'article: Didactique de formation des enseignants Etude des conceptions en situation de formation	Objectifs: «incitation à l'activisme» «action communautaire raisonnée» «recherche-action orientée pour l'action sociopolitique» «résolution démocratique de problèmes»

Note: La plupart des informations du tableau ci-dessus sont le fruit d'une lecture orientée des contributions publiées dans l'ouvrage de référence, suite au symposium de Toulouse de 2014. Les contributions sont classées (de 1 à 11) en fonction de leur perspective transformatrice explicite ou présumée[5].

Quelques remarques :

Ces quelques travaux et d'autres – portant sur les QSV - s'inscrivent bien dans une perspective didactique. Par contre, il n'est pas certain que tous leurs auteurs adopteraient la même définition d'une « étude didactique d'une QSV ».

Par ailleurs, les objectifs en terme d'engagement se situent bien sur un gradient allant jusqu'à « l'activisme », mais de nombreux auteurs se situeraient - a minima - dans une perspective « transformatrice » modérée. L'introduction dans le corpus d'études menées, - par exemple dans une perspective de didactique chevallardienne[6] de « pédagogie de l'enquête » (Chevallard & Ladage, 2011) -, pourrait mener à élargir le gradient. De plus, les objectifs de certains auteurs « historiques » des QSV ont pu évoluer, comme nos propres travaux qui s'inscrivent désormais dans une perspective transformatrice-critique (Legardez & Jeziorski, 2014 ; Panissal, Jeziorski & Legardez, 2016).

Ces propositions devraient évidemment à nouveau être soumises au débat avec les auteurs concernés et complétées par un enrichissement collectif, notamment en examinant d'autres travaux qui se positionnent dans la thématique des QSV. De même manière, les propositions sont faites pour aller vers des modélisations des processus de didactisation sur des QSV, qui seront, elles aussi, soumises à la discussion de la communauté des chercheurs de notre thématique.

VERS DES MODELISATIONS DU PROCESSUS DE DIDACTISATION DE QSV

Dans un premier temps notre grille d'analyse des QSV sera revisitée en termes de légitimité, de vivacité, de didactisation et de problématisation avant, - dans un second temps -, d'examiner des propositions de modélisation utilisables pour des études sur le processus de didactisation des QSV.

5 Il a été tenu compte des remarques des auteurs, mais ce classement reste imputable l'auteur de cette contribution.

6 Dans le cadre théorique de la théorie anthropologique de la didactique (TAD) créée et systématiquement utilisée dans les travaux de Chevallard et des chercheurs qui se réclament de cette théorie.

DES PROPOSITIONS DE GRILLES D'ANALYSE

L'entreprise de modélisation sur des QSV n'est pas nouvelle. Les premiers chercheurs engagés dans cette thématique : Laurence Simonneaux, Virginie Albe, Yves Alpe, Alain Legardez … avaient déjà avancé quelques propositions, notamment dans le premier ouvrage collectif sur les QSV (Legardez & Simonneaux, 2006). Sans prétendre à l'exhaustivité, on peut évoquer d'autres modélisations qui sont venues ensuite.

Quelques contributions :

Sur la légitimité des savoirs scolaires

Des travaux collectifs, – réalisés notamment en lien avec l'INRP-IFE, dans le cadre d'ANR ou de projets européens[7] – ont permis de construire les variables pour la modélisation didactique sur des QSV. Concernant la variable « légitimité », on peut se référer à la définition des trois formes de légitimité des savoirs scolaires par Yves Alpe (Alpe, 2006, pp. 241-242) :

> [La légitimité scientifique] … qui se constitue par référence aux savoirs savants, caractéristique du modèle académique et du modèle de la transposition didactique », la légitimité institutionnelle « … qui résulte de la mise en forme scolaire d'un projet politique (éduquer, enseigner). Elle s'appuie sur le processus de disciplinarisation » des contenus, et va se traduire par la forme réglementaire donnée aux programmes officiels, aux instructions … », [et la légitimité social]e « qui s'élabore à partir des représentations sociales de la fonction de l'école et des interprétations des acteurs ».

On peut remarquer que l'action conjointe de ces trois types de légitimités et de leur évolution convergente ou divergente conduit à des modifications des savoirs scolaires, particulièrement lorsqu'il peut s'agir de questions potentiellement vives qui rentrent dans l'école, inquiètent les disciplines et tendent à remettre en cause la forme scolaire traditionnelle. L'introduction, puis la montée en puissance des « éducations à », nous semblent être l'un des plus puissants vecteurs de cette évolution récente qui donne probablement plus de visibilité et d'intérêt aux travaux sur les QSV et leur didactique (Tutiaux, Simonneaux & Legardez, 2013).

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7 Par exemples :
Recherche ANR « E2DAO » Education au développement durable ; appuis et obstacles (ANR – 08 –BLAN – 0135 -03) avec l'UMR STEF - ENS Cachan (J.-M. Lange), l'ENFA de Toulouse (L. Simonneaux), l'EA 4671 ADEF (A. Legardez) et le MNHN de Paris (Y. Girault) (2009-2012).
Recherches sur « l'enseignement de questions vives liées aux environnements », UMR ADEF et INRP-IFE (n°39141) (2009-2012) ; resp. A. Legardez.
Projet européen Erasmus+ STEP (2015-2018) sur l'éducation à la citoyenneté : « School Territory Environment Pedagogy » - « Citizenship pedagogy and teatcher education ».

Sur la vivacité, la contextualisation et l'implication

Certains contributeurs du symposium de Toulouse ont également proposé des modélisations, dont voici deux exemples, - évidemment sans intention d'exhaustivité -.

C'est ainsi que A. Lipp, M. Vidal et L. Simonneaux (2014, p. 128) postulent que le « degré de vivacité » d'une QSV dépend :

> […] de la dynamique d'évolution des débats et des savoirs ou pratiques faisant référence, des valeurs mises en jeu et de l'intensité de l'engagement des acteurs.

Par ailleurs, L. et J. Simonneaux (2014, pp. 118-119), - s'appuyant notamment sur leurs travaux sur la réintroduction de l'ours dans les Pyrénées et du loup dans les Alpes -, évaluent l'impact comparé des degrés d'implication et d'affect des acteurs concernés :

> […] plus la proximité de la question traitée est grande avec les étudiants – question locale impliquant du fait de leur origine socioculturelle – plus l'apprentissage scientifique (analyse critique de leurs conceptions, appropriation de connaissances, réflexion socioépistémologique sur les savoirs impliqués, raisonnement) est faible. Tant l'emporte la surexpression de l'affect sur certaines QSVE[8] en fonction de facteurs culturels. Mais sur certaines QSV, la mobilisation de l'affect favorise la recherche de contre arguments scientifiques pour réfuter des positions divergentes (Jimenez-Alexandre, 2006).

Ils font donc aussi remarquer que ces déterminants peuvent jouer dans un sens différent selon les contextes, ce qui devrait nous conduire à tenir le plus grand compte de la contextualisation de nos études (Bader, Barthes & Legardez, 2013 ; Floro, Jeziorski & Legardez, 2015).

On pourrait trouver d'autres propositions de modélisations dans de nombreux autres travaux sur les QSV et il serait d'ailleurs intéressant d'en faire une recension systématique et une analyse comparative.

Les trois étapes de la production de savoirs sur des QSV

Dans le texte de Legardez et Jeziorski de la Revue Francophone du développement durable (2014-4) et concernant les « Rappels, approfondissements et pistes », il était fait allusion - au titre des questions récurrentes dans les travaux sur les QSV - à leurs « légitimités, vivacités et risques » (pp. 24-25). Mais il semble nécessaire de reprendre la réflexion sur ces caractéristiques et de la compléter en termes de légitimités et de vivacités, de didactisation et de problématisation, - toujours en relation avec notre grille d'analyse en termes de rapports aux savoirs revisitée[9] : savoirs de références, savoirs

[8] QSVE : question socialement vive environnementale.

[9] Voir plus loin notre schéma revisité (Figure 1).

sociaux et savoirs scolaires ou de formations (Legardez, 2004, 2006 ; Legardez & Simonneaux, 2011).

Dans le cadre du processus de transposition didactique externe (sphère de l'expertise), on peut étudier les degrés de légitimités de la production des savoirs institutionnels scolaires et de formation sur des QSV (leurs curriculums) que construisent les experts en relations avec des savoirs de références : savoirs scientifiques, savoirs experts, pratiques professionnelles, parfois même de savoirs locaux (Floro, Jeziorski & Legardez, 2015) et des savoirs sociaux. Les estimations de ces degrés de légitimités auraient une forte influence sur les choix des experts au regard des distances qu'ils choisissent de prendre par rapport aux deux savoirs non scolaires (ou de formation) dans leur production de curricula (prescrits).

Dans le cadre du processus de transposition didactique interne (sphère de l'enseignement et de la formation), on peut étudier les degrés de vivacités potentiels de QSV, ressentis ou anticipés par les enseignants ou les formateurs, au regard des savoirs de référence et des savoirs sociaux, voire des savoirs scolaires (ou de formation) institutionnels. Les anticipations de ces degrés de vivacités auraient une forte influence sur les choix des enseignants ou des formateurs au regard des distances qu'ils choisissent de prendre par rapport aux deux savoirs non scolaires (ou de formation) ainsi qu'aux savoirs institutionnels et donc pour la production de leurs savoirs à enseigner : leurs curricula réels, cachés, voire « sournois » (Alpe & Legardez, 2013).

Les stratégies de didactisation (externe et interne) sur des QSV seraient alors fonction de la prise en compte de degrés de légitimités et de degrés de vivacités estimés et anticipés. Et elles détermineraient les constructions de distances par rapport aux différents savoirs, ainsi que les degrés de problématisation proposés dans les savoirs institutionnels et les savoirs intermédiaires (manuels, internet …) ou choisis par le formateur dans sa préparation et son intervention, en fonction de ses objectifs, de la situation didactique et de son appréhension du réseau de contraintes.

Outils pour une analyse didactique

On pourrait postuler qu'un objet d'enseignement ou de formation qui fait débat (selon des degrés de vivacités et de légitimités) dans au moins l'un des trois genres de savoirs - savoirs de référence (SRef), savoirs sociaux (SSoc), savoirs pour l'enseignement-apprentissage (RpEA) – est susceptible d'être étudié dans la perspective de la didactique des QSV. Et l'on pourrait aussi repérer trois grandes catégories de situations didactiques selon les degrés de vivacités (dv) et en fonction des conséquences sur le risque d'enseigner et le risque d'apprendre (Legardez & Jeziorski, 2014, p. 25). Nommons alors *« degrés de sensibilité didactique »* la résultante des différents « degrés de vivacités » et tentons d'illustrer la pertinence de cette proposition par trois exemples.

Cas n°1 : Sensibilité didactique faible
SSoc (dv faible) : (quasi) absence de savoirs sociaux, mais possibilité de savoirs appris
SRef (dv forte) : références scientifiques parfois controversées
SpEA (dv variable) : selon les degrés de problématisation choisis dans TDE et/ou TDI

Dans ce premier cas, on peut penser que le risque potentiel d'enseigner est faible, que le risque d'apprendre est faible lui aussi, mais qu'il peut exister un risque d'obstacles didactiques (dus à des apprentissages antérieurs). C'est ainsi que l'enseignement de la comptabilité nationale en économie se heurte rarement à des savoirs sociaux (quasi) inexistants et que les formateurs choisissent très rarement de faire mention des controverses des spécialistes. Par contre, des obstacles de type didactique peuvent apparaître pour des apprenants qui réintroduiraient des éléments de savoirs appris antérieurs, non homogènes aux nouveaux savoirs enseignés.

Cas n°2 : Sensibilité didactique moyenne
SSoc (dv forte) : opinions divergentes
SRef (dv faible) : quasi consensus dans les références scientifiques
SpEA (dv variable) : selon les degrés de problématisation choisis dans la TDE et/ou la TDI

Dans ce deuxième cas, on peut penser que le risque d'enseigner est faible, puisqu'il y a un quasi consensus dans les savoirs de références ; par contre, le risque d'apprendre existe, puisqu'un tel objet d'enseignement scolaire est très discuté dans les savoirs sociaux. C'est ainsi qu'un enseignement sur le réchauffement climatique pourrait ne pas poser de problème de TD, puisqu'actuellement la quasi-totalité des spécialistes sont d'accord sur l'existence et l'ampleur de ce phénomène. Par contre, le formateur pourra se heurter au scepticisme des apprenants qui se réfèreraient à leur propre vécu à court terme. Une stratégique didactique de type « refroidissement » de la QSV(Soc) pourrait alors être choisie par le formateur. Par contre, si l'enseignement portait sur la question de la limitation de ce réchauffement, nous pourrions nous trouver dans le cas n°3.

Cas n° 3 : Sensibilité didactique forte
SSoc (dv forte) : RS ou opinions divergentes
SRef (dv forte) : savoirs controversés (scientifiques, pratiques professionnelles, savoirs locaux)
SpEA : potentiellement assez fort, selon les degrés de problématisation choisis dans TDE et/ou TDI

Dans ce troisième cas, on peut penser que le risque d'enseigner est fort, puisqu'il n'y a pas de consensus dans les savoirs de références, mais au contraire des controverses qu'il peut être difficile pour le formateur de maîtriser et transposer. De plus, de telles questions sont souvent fortement débattues et discutées dans les savoirs sociaux et elles interpellent l'apprenant, par exemple en l'incitant à importer ses savoirs sociaux dans la situation didactique et/ou à se sentir stigmatisé et refuser d'entrer dans une stratégie d'apprentissage. C'est ainsi qu'un enseignement sur la transition énergétique pourrait

poser de délicats problèmes d'accès aux SRef ainsi que de TD, puisqu'il n'y a pas actuellement de consensus parmi les spécialistes, - si ce n'est sur l'existence de la question -, mais pas sur ses causes, son urgence, ni sur des solutions pour une transition. De plus, le formateur pourra se heurter au scepticisme, à la stigmatisation, voire à l'opposition des apprenants qui se réfèreraient à nouveau à leur vécu. Une stratégique didactique de type « neutralisation » des débats dans les QSV(Ref) et de « refroidissement » de la QSV(Soc) pourrait alors être choisie par le formateur … alors même que les travaux de didactique des QSV tendent à montrer que la stratégie du débat argumenté serait potentiellement la plus efficace.

On peut encore faire remarquer que le degré de sensibilité d'une QSV peut varier. C'est ainsi que la question du réchauffement (ou du changement) climatique (Legardez, 2016) était probablement vive dans les SRef voici encore quelques années, lorsque les rapports du GIEC n'étaient pas encore aussi consensuels et que certains contradicteurs étaient très présents dans les médias[10]. Plus généralement, on peut avancer que le formateur aurait à faire preuve d'une grande vigilance lorsqu'il travaille sur une question potentiellement vive, - soit nouvelle, soit latente -, et particulièrement là où les conflits de valeurs sont potentiellement forts (Legardez, 2006).

VERS UNE DIDACTIQUE DES QUESTIONS HYPERVIVES

L'hypothèse des questions « hyper-vives »

L'élaboration d'une nouvelle version de la grille d'analyse des questions socialement vives (QSV) – développée initialement (Legardez, 2006) en termes de gestion des rapports aux savoirs dans le processus de production des savoirs scolaires et de formation – nous semble permettre une analyse spécifique de nouvelles questions « hyper-vives » liées aux éducations à (notamment au développement durable, aux changements et aux transitions). L'objectif de la formation n'est alors plus seulement l'enrichissement des connaissances sur des objets d'apprentissage – qui renvoient à des controverses dans les références et qui sont confrontés à des obstacles dans les savoirs sociaux des apprenants –, mais une formation à un ensemble complexe de savoirs, de pratiques et de valeurs dans une perspective transformatrice-critique (Jickling & Wals, 2013 ; Panissal, Jeziorski & Legardez, 2016) orientée vers l'action.

Cette grille revisitée vise à éclairer les stratégies didactiques des formateurs, en repérant des obstacles et des appuis au processus d'enseignement-apprentissage sur ces questions qui intègrent des rapports aux valeurs, aussi bien au regard des références des enseignements que dans les systèmes de représentations-connaissances (SRC) des apprenants, et donc, dans la production des savoirs scolaires ou de formation.

Nous travaillons désormais sur les spécificités des savoirs, des pratiques et des valeurs qui sont liés à l'enseignement-apprentissage sur des questions que nous proposons de nommer « hyper-vives » dans un triple sens. D'une part, elles concernent des questions fondamentales, incontournables et souvent urgentes – comme par

[10] Et l'on peut s'interroger sur les conséquences de l'accès à la présidence des USA d'un climato sceptique.

exemples, celles des transitions écologique, climatique et énergétique. D'autre part, elles sont en rapports avec des savoirs, des pratiques mais aussi des valeurs, dans les références ainsi que dans les SRC des apprenants. Enfin, l'objectif des apprentissages ne vise pas seulement l'acquisition de connaissances, mais aussi l'action – via la réflexivité, l'engagement et la prise en compte des émotions – pour la formation d'un (futur) citoyen instruit, critique et engagé.

Les processus de production des savoirs, pratiques et valeurs sur des questions hypervives

Des travaux récents menés sur des questions liées à la citoyenneté (Legardez & Jeziorski, 2017 ; Legardez, Jeziorski, Floro & Fauguet, 2017) ont permis de proposer et de discuter une nouvelle version du modèle de production des savoirs de formation, notamment en y incorporant plus clairement les pratiques et en y ajoutant les valeurs qui nous semblent alors incontournables dans toutes les étapes du processus. Nous proposons encore d'ajouter une nouvelle étape en fin de processus, celle de la « transposition didactique citoyenne » qui en serait l'étape (provisoirement) finale. Il s'agit bien alors d'une perspective transformatrice-critique qui rapproche notre modèle des positionnements à visée les plus transformatrices et centrées aussi sur l'action.

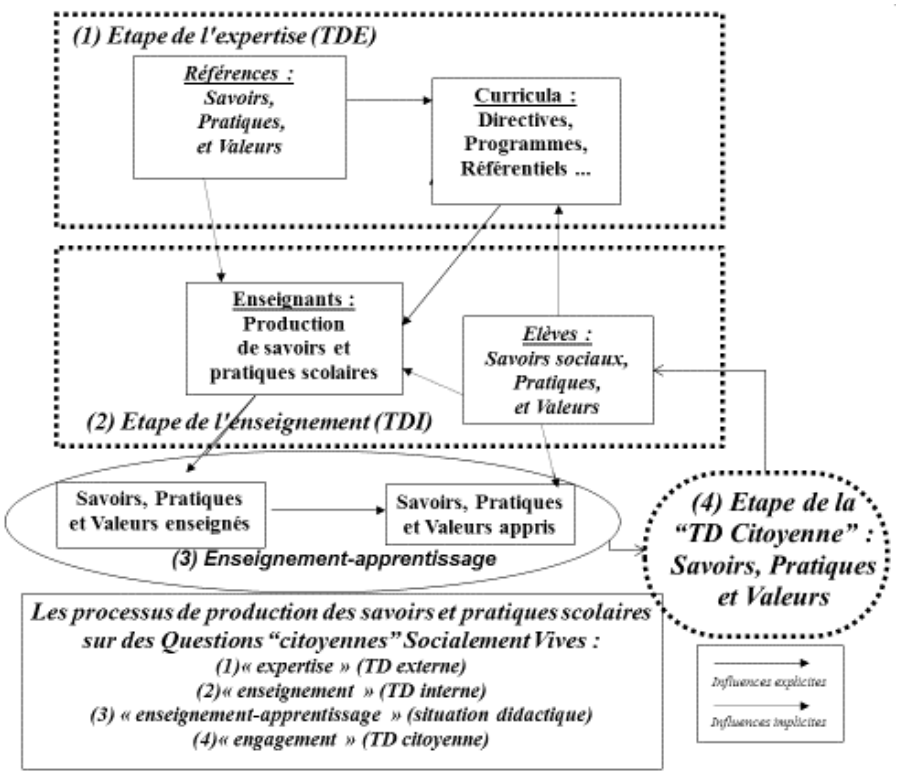

Figure 1. Modélisation de la succession des transpositions sur des questions hyper-vives (Legardez & Jeziorski, 2017).

Remarquons encore que ce processus est continu et spiralaire, puisque les savoirs, pratiques et valeurs apprises, – acquis et co-construits dans le processus –, sont réinjectés par les apprenants dans le circuit d'enseignement-apprentissage au niveau des systèmes de représentations-connaissances (savoirs, pratiques et valeurs issus de leur insertion sociale – enrichis des savoirs, pratiques et valeurs acquis dans les précédents apprentissages).

CONCLUSION

En s'appuyant sur nos nouvelles propositions, on pourrait repérer une relative convergence globale vers un objectif de transformation de la société, mais selon un gradient déjà proposé par Laurence et Jean Simonneaux (2014, p. 111) à propos des enjeux éducatifs de l'enseignement de questions socio-scientifiques. Ce gradient irait d'un objectif « de rationalité » qui correspondrait à une zone d'enjeux « froids », jusqu'à un objectif « d'activisme » qui engendrerait une zone d'enjeux « chauds ». Le choix d'une perspective « transformatrice » serait plus propice à l'émergence ou au développement de QSV dans l'enseignement et la formation … et à l'éclosion d'études sur des problèmes de leur didactique. On pourrait alors repérer, – en s'inspirant aussi de l'étude ci-dessus (par exemple à l'aide de la caractérisation proposée) –, au moins quatre niveaux d'objectifs ou de finalités plus ou moins « transformatrices » :

Quelles finalités (objectifs) pour des recherches « sous l'angle des QSV » ?
F1 : Production de savoirs académiques sur les processus d'enseignement et d'apprentissage de savoirs curriculaires
F2 : F1 + des objectifs d'aide à la réflexion et à la pratique des acteurs du processus d'enseignement-apprentissage
F3 : F2 + perspective transformatrice
F4 : F3 + perspective activiste

Il faudrait aussitôt préciser que (le plus souvent) il s'agit plus de gradations que de catégorisations. C'est ainsi que certains considèrent que la perspective transformatrice se trouve déjà en F2. D'autres soutiennent qu'il n'y a pas de différence de nature entre la perspective activiste et la perspective transformatrice[11].

Enfin, et pour en revenir aux objectifs de ces propositions de caractérisation-modélisation – revisitées et « revivifiées » – leur ambition consiste à se positionner comme des éléments de théorisation sur des questions de didactique des QSV, et donc comme des briques de savoirs susceptibles de contribuer à poursuivre la co-construction de notre champ de recherche sur les QSV, pour contribuer aussi à éclairer la réflexion et les pratiques des acteurs de l'enseignement et de la formation, dans une perspective renforcée et explicitée de transformation de la société.

11 Ici encore s'ouvre un espace pour un élargissement-approfondissement de l'analyse.

ANNEXE

Sommaire de la Revue Francophone du développement durable 2014, n°4 : « Les questions socialement vives » :
Note : Les chiffres (n) font référence à la classification du tableau n°1

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LEARNING MULTIMEDIA AND SOCIAL ACTIVISM

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ABSTRACT

The technology-based courses are not usually related to issues of social significance, but the contact points may be strong enough to justify a study assessing the relationship between participation in socially significant projects for students and their technology learning curve. Students with technical and computers capacity can perform citizenship actions, particularly in terms of dissemination, but will these students be aware of their ability? And the involvement of these students in social projects can improve their technical competence? Thus, in the present study we intend to evaluate the education potential of an educational multimedia socio-political action-based project. The combination of education, technology and socio-political activism is sensitive and requires constant clarification of meanings and intentions. However, studying the relationship between social issues and the acquisition of technological capabilities in school context can be a starting point for other studies about civic training and active citizenship of young students.

KEY WORDS

Activism, Case-Study, Education, Citizenship, Multimedia.

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ENSINO DE MULTIMÉDIA E ATIVISMO SOCIAL

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RESUMO

A combinação de ensino tecnológico, questões de cariz social, ativismo sociopolítico, educação e projetos de intervenção são pouco habituais mas existem dimensões comuns que justificam um estudo para avaliação da relação a participação em projetos socialmente significativos para os alunos e a sua aprendizagem de tecnologia. Estudantes tecnologicamente capacitados podem realizar ações de intervenção mais abrangentes em termos de alcance e divulgação, mas terão estes jovens, consciência do seu poder? O envolvimento destes alunos em projetos de intervenção social para eles significativos aumentará a sua competência técnica? A conjugação de ensino, tecnologia e ativismo sociopolítico é sensível e exige clarificações constantes de significados e intenções, mas relacionar questões sociais e aquisição de capacidades tecnológicas em contexto académico pode ser um ponto de partida para outros estudos que aprofundem as questões de capacitação cívica de jovens estudantes.

PALAVRAS-CHAVE

Ativismo, Multimédia, Estudo de Caso, Educação, Cidadania.

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Learning Multimedia and Social Activism

Nuno Albano

INTRODUCTION

CONTEXT

The current socio-economic situation, with all the difficulties associated, makes young students perceive that they will not have good career prospects, affecting their learning motivation. On the other hand, these same economic difficulties lead to complicated social situations, which although experienced by students, do not provoke any action aimed to solve it. Azevedo and Menezes (2010), from the works of (Delicate, 2003; Menezes et al., 2003; Putman, 1995), claim that although the democracy vitality depends on the involvement and participation of citizens, there is a trend of apathy and political scepticism, not exclusive of youngsters, revealed by a huge lack of interest in political involvement. Meanwhile, there are a lot of social issues that ordinary citizens feel unable to solve. The young students, often endowed with a strong proficiency in Web 2.0 tools do not have a real awareness of their civic intervention capacity.

In this context, the author is developing since 2013 a study in a school with a century-old tradition in technological education, aiming to use the technological abilities of students to solve social problems that they consider as significant, allowing them to acquire the perception that the subjects learned have practical significance in their lives. The technology-based courses are usually not associated to social issues, but the technical training of young students can contribute to their growth as citizens, through their involvement in socially significant projects. Those projects should not only address their every-day life concerns but also impact their learning experience as motivating factors. In this perspective, the social projects should not distract the student from their academic life, but improve it, as defended by Wentzel (Seminar, May 23, 2014): "the pursuit of multiple goals, social and academic, is important for academic achievement".

PERCEPTION OF EMPOWERMENT

Another point to consider is the fact that students, although working quite efficiently with Web 2.0 tools, have not yet acquired the knowledge that these technologies have an extreme potential of problem solving for some of their social issues, i.e., the students do not have the awareness that the technological tools they master are already powerful weapons in socio-activism projects (Stegmann, Weinberg & Fischer, 2007). Additionally, the perception that these students have about the process they are involved should be

evident. In other words, we intend to understand whether, as stated by Kelner (1995, cited in Kelner & Kim, 2010), the students involved realize that “emergent technologies provide the potential that individuals can ‘empower themselves in relation to dominant media and culture’” (p. 6), as well as to what extent they consider they are doing civic and social intervention and if that involvement has improved or not their learning.

The students participating belong to IT and Multimedia courses, meaning that they have technological intervention capabilities superior to ordinary citizens. It is now known the action of social networks and tools like Facebook, Twitter or Youtube to trigger popular protests from the Middle East to the Western world outrage movements, but are vocational students aware that their training in the field of image, audiovisual and web production enables them to produce advanced forms of social intervention? Can the media students produce videos that influence public opinion on social issues that concern them? And can the production of these videos catalyse a need to acquire greater expertise, which could motivate a greater need to know, stimulating the will to learn the proposed curriculum of their course?

SCHOOL MISSION

It can be considered that the academic work with social engagement are potential catalysts of increased civic consciousness, saying Bader and Laberge (2014), from Greene works (1995), that students can discover a sense of responsibility associated with citizenship, both from their own experiences as social care beneficiaries or providers, or from their own conceptions of justice and equality. This awakening of civic and social consciousness is one of the school functions according to several authors, saying Alsop and Bencze (2014), based on studies of Blatt (2014), Bader and Laberge (2014) and Zoras and Bencze (2014), that the education systems have "rights of enhanced democratic representation and participation (....) Education, in this light, shifts from an a-priori of political agency to the project of supporting active political engagement and Involvement" (p. 15). Besides, according to Azevedo and Menezes (2010), participation in civic projects, particularly in schools, should be considered as crucial opportunities to develop skills for involvement in social issues and citizenship.

RESEARCH QUESTIONS

Among the questions that motivated this study, are those related to the interconnection between technology education and social intervention, particularly in terms of its potential: The use of ICT in social-oriented projects contributes to increasing civic awareness of students? And improves their technological competence? Multimedia students acquire the perception that their technological capabilities enhance their social participation? Multimedia students develop the perception that their technological capabilities are important for the exercise of citizenship and democratic problem solving?

What are the capabilities of a multimedia teaching based on socio-political action projects?

So, to address this issue were defined the following research questions:

- What is the impact of the development of multimedia projects of socio-political action on active citizenship skills of students?
- What is the impact of the development of multimedia projects of socio-political action in technological skills of students?
- What are the relationships that students identify between their technological skills and the exercise of active citizenship?
- What are the relationships that students identify between their technological skills and democratic problem solving?

CONCEPTS CLARIFICATION

ACTIVISM

Among the concepts that should be clarified, there is activism, which has multiple interpretations and is not free of controversy and divergent views: "the label of 'activism' is wrapped up in a series of fractured and imprecise social imaginaries that are themselves not without either potential or concern. At the heart of most of these are desires to act to bring about change. The Oxford English Dictionary describes activism as 'intentional efforts to promote, impede or direct social, political, economic or environmental change'. Other definitions cast light on the agent, the protester engaged in pursuit of a particular specific cause" (Alsop & Bencze, 2014, p. 8). Among the various answers to the question of understanding the socio-political action, Sperling, Wilkinson and Bencze (2014), associate activism to a participatory citizenship: "The term active, or participatory, citizenship relates to an indication by actors that they are involved in community life, that they have acknowledged the positive and negative possibilities of their actions" (p. 372). Bernhard Isopp (2014) sees activism as uncompromised from groups with strong institutional power and quoting Woodhouse et al. (2010), presents another version: "By the term 'activism,' we refer to a range of methods used by groups with relatively little institutional power attempting to influence opinion, policy or practice toward democratic and other normative ends" (p. 319). Returning to Alsop and Bencze (2014), these authors associate the socio-political activism to a fairly standard concept, unifying different trends and goals: "It is an action orientated and generative term and thereby offers the prospect of identifying with others and acting with common goals" (p. 9). Thus, explaining the concepts of social and political activism through Banks (2009) social intervention models, in conjunction with the STEPWISE model (Bencze & Carter, 2011), the author assumes in this study that socio-political activism can be understood as a conscious action of a group for the purpose of generating social change.

ACTIVISM AND EDUCATION

Another aspect that should be clarified in this study is the link between activism and education. The importance of school as a social transformation vector is present in several authors, as Kelner and Kim (2010) who claim that “critical perspectives on education’s role in societal as well as individual developments, it can also be a democratizing force and promote cultural revolution and social transformation (p.3). Authors like Bencze and Carter (2011) or Roth and De'sautels (2002) argue that the inclusion of activism processes in education, not only increases the students’ knowledge about the issues addressed, but their skills in scientific research as well, besides, and this is not to belittle, it increases their civic awareness. But caution must be present, since socio-political action can incorrectly be associated to ideologies or political parties: “activism can become erroneously associated with ideologically entrenched ideologies, practices of indoctrination that are intolerant of differences and unable or unwilling to critically self-reflect and learn from and with others” (Alsop & Bencze, 2014, p. 8). This connection can limit the use of activist processes in education, because it can look suspicious in the interpretation of school governing bodies or the conviction of the students’ parents. Thus, it should be clear from the start that the projects chosen by the students will have no connection to political party initiatives, but seeks instead to work citizenship issues. Providing students with tools of civic participation and framing the disciplines subjects in a perspective of social intervention can make the school consider the young students not just as future citizens but as citizens with full civic rights and duties capability (Invernizzi & Williams, 2009).

A 2008 study, authored by Azevedo and Menezes has shown that young people have a low interest in terms of traditional political participation and do not trust politicians or governments and by consequence these students don´t discuss any aspects of the political situation with their teachers. However, this same work documented the consistent importance of the classroom context in the formation of a predisposition for future civic participation, pointing out the centrality of school in developing political interests of young people.

TEACHER AUTHORITY AND STUDENTS AUTONOMY

The teachers’ authority in the classroom is not questioned, although this kind of intervention requires strong skills in technical knowledge, project management and objectives definition: “This does not mean we do not recognize the teacher's authority, but this authority is linked to his / her competence, based on clear and shared objectives. The same authority can be given to students (....) as they develop knowledge and take a stand on (....) issues of importance to them" (Bader & Laberge, 2014, p. 423). The authors quoted above also point that as students gain knowledge, their responsibility can improve and they can take relevant roles in managing their projects. In this perspective, this study seeks to develop work with students from four different levels of education, from the eighth to twelfth school year, in order to be able to engage participants at

various levels of self-management. In this line of reasoning, Hodson (2014) states that students can gain experience in activist initiatives through the influence of their teachers in a three-stage process. Initially the teacher demonstrates and explains the desirable behaviour, illustrating with examples. In the second stage of guided practice, students perform specific tasks integrated into a wider global strategy, being directed and assisted by their teachers. In the third phase of application, students act independently of the teacher, using the concepts and skills previously acquired. In the theory advocated by this author, students will be much more efficient in planning, implementation and evaluation of socio-political actions when they observe teachers and experts in action, practice skills in a position directed by teachers, are assigned planning and organization tasks and engage in evaluation and self-criticism under the guidance of teachers and participation of their colleagues.

The students autonomy is an essential aspect of this study, with authors like Wentzel (2009), advocating that if teachers develop the autonomy of the students, this will improve their performance, which will lead to more positive academic results. Agreeing with this conclusion, Reeve (2009) states that the development of students' autonomy, structured and supported by teachers, contributes to a greater academic effort by the students: "it is clear that both students and teachers function better in school when teachers support students' autonomy" (p. 172). The student-teacher relationship is paramount in the development of the students autonomy, which is a potential precursor of motivation, with the consequent gains in academic achievement, because as recorded in Cheon, Reeve and Moon (2012) when "students perceived that their teachers became more autonomy supportive and less controlling, they experienced psychological need satisfaction, and they reported meaningful gains in their classroom engagement, skill development, future intentions, and course achievement" (p. 392).

The work of Wentzel, Baker and Russell (2012), examining the extent to which academic results of students from ethnic minorities were affected by social perceptions of teachers and their peers, can give some clues and provide information to work with the group involved in this study and how students can be addressed, although precautions are necessary, given the differences in context: "Researchers have documented significant relations between students' positive interactions and relationships with teachers and their academic and social accomplishments at school"(Wentzel, 2009, p. 301).

METHODOLOGY

STUDENTS WORK METHODOLOGY

The school analysed in the present study follows motivating policies for students focused on external partnerships and projects oriented for their future professional reality, with a strong practical component (Programas das disciplinas técnicas do Curso Profissional de Multimédia, 2006-2007). Also, these partnerships with external entities, intend to provide social and cultural organizations with multimedia and audiovisual materials

produced by these students. By doing this, we intended to make students realize that their school work can mean an improvement in their social situation. Thus, in this context of social partnerships, these students have produced since 2009, a full range of multimedia, audiovisual and graphic materials, including films, interactive DVDs, photographic works, posters and leaflets aimed to interconnect their academic tasks with real products used by solidarity organizations.

In order to strengthen the components of social intervention, the multimedia students have integrated the University of Lisbon project " We Act - Promoting Collective Activism on Socio-Scientific Issues" as described in Reis (2014), using the following methodology: a) discussion of social issues deemed relevant by the students; b) stimulating their participation in their resolution, through the search for solutions in an active and democratic perspective; c) production of audiovisual materials in conjunction with non-governmental organizations (NGOs) associated with the resolution of the problems discussed. Thus, concepts and working methods associated with the socio-political activism were introduced in the teaching practice of the Multimedia course. The students debate, identify problems and propose solutions, in a compromise between social issues significant to them and answers involving their technological skills, acquired in their academic work.

Under the earlier WeAct project involving the Multimedia students, a classroom methodology was created, consisting in a debate about the topics deemed relevant by the students, followed by a theme selection not limited by the teacher, although he can provide a framework. After this phase, the students proceeded to research NGOs related to the theme they have chosen, allowing a contact to carry out a collaborative process. This whole process is based on a strong students volunteer commitment, with work out of their school schedule, showing a great volunteer component and interdisciplinary collaboration between students from different school years, consistent with the opinion of Wentzel (Seminar, May 23, 2014): "students are likely to engage in positive social and academic activities at school if the school provide them with this option". Despite this students' self-decision component, their work is always evaluated by the teachers of the different disciplines involved, not only to allow the inclusion of the project in the teaching planning, but also to provide additional motivation.

The working process can be summarized by the following sequence of actions:

- Discussion of topics deemed relevant by the students at the suggestion of the teacher or the students themselves, which are then selected freely by.
- In a second phase the students search for public and/or NGOs involved in the field of activity concerned, which are then contacted in order to carry out a collaborative process.
- In the third phase, the work developed is delivered to the partner organizations and evaluated both by these and academically by the teachers of the disciplines involved.

The multimedia materials already produced by these students have been used by several partner organizations in their real activities and the students have been present in several major education meetings, European programs and social media networks discussing their work.

RESEARCH METHODOLOGY

This study is being developed with a multiple case methodology, according to the concepts and protocols of Yin (2014), Miles and Huberman (1994), Willig (2001) and Eisenheardt (1989). The participants are 65 media students spread over four levels of education (8th, 10th, 11th and 12th years), i.e. from basic to secondary. The 8th graders do not belong to the professional course of multimedia, like the rest, but to a new educational option, the vocational courses. Their inclusion is due to the fact that these students have the multimedia teaching as a common point with the other, and the different type of education will allow establishing some comparisons. These four groups are submitted to an overall analysis, including questionnaire, classroom observation, work evaluation and focus-group. This general component will be complemented by a further analysis of eight of these students, two from each class, with individual interviews. In addition to the four classes and its eight students involved more particularly, the author will also include interviews with multimedia students who completed the course in recent years with social-oriented projects, in order to understand the impact in their professional life.

The vast majority of participants have prior knowledge of the author, and the familiarity between observer and observed, can be seen as an advantage and simultaneously as a disadvantage: It is advantageous in facilitating the approach and overcoming any concerns on the part of the students, but has the potential disadvantage of bias observation. Thus, the author shall keep records containing information for further analysis, including detailed descriptions, dating sessions, comments and reflections.

In terms of research and data collection and analysis procedures, the author uses several instruments, as described below:

- Surveys pre and post-test to a group of 65 students involved in activism projects
- Observation of lessons and evaluation of developed work
- Individual interviews to 8 students who are accompanied with more detail.
- Focus group of four sub-groups of participants
- Testimonials from previous years' students.

This methodology allows procedure triangulation with the collected data processed by content analysis. The chosen sequence of questionnaires, individual interviews and focus-group intends that there is no "opinion contamination", trying that the group approach does not influence individual responses to the questionnaire.

ETHICAL ISSUES AND STUDY LIMITATIONS

This kind of study raises some ethical issues, and an important aspect to consider is that an investigation of this kind should give to the participants the right to do not participate

or to withdraw (Gray, 2012). In practical terms, the status of the author as the participants teacher, can difficult this, even if some aspects of the work done has a volunteer component. Anyway, the experience in previous projects enables the author to say that non participation is rare among these students, so the violation of the withdraw right is not expected (Albano, 2012). Anyway, it is important to maintain attention, in order to enable students who don´t want to participate in data collection.

Another ethical aspect to consider relates not to the collection and processing of data, but with the consequences of the social work done by the students, as it is intended that these actions have impact on the community. Roth (2014) warns that allowing students' involvement in social-oriented projects should not be seen by the teachers as a good deed, but as an action that implies responsibility for educators and has "considerable implications. We may no longer simplistically feel good about ourselves when we enable students to participate in activism and science education as/for socio-political action" (p. 252).

Finally, we must take into account that it is not by doing an action towards the community that this is implicitly positive. This should be consciously shared with the students involved. Thus, it must be present that the assumption of the ever-positive consequences of this kind of action also has ethical implications, and working under the presumption that this initiative have a hallmark of correctness and goodness to the community means that we can lose perspective and perhaps those who propose and develop the action will develop a perception that have not a real match in society.

It must also be considered that research based on case studies has limitations in terms of generalization of results (Miles & Huberman, 1994; Yin, 2014; Willig, 2001), so the definition of the limits of this study should be clear. Besides, in this particular study, the social intervention aspects, involve a different type of limitations, since socio-political activism in education is a sensitive issue and implies special care with the way this subject is approached in the classroom and treated by the students: "Introducing activism in science education classrooms can be seen as provocative or debatable. Any approach in that sense must be made intelligently and with nuance in order to be legitimized" (Bader & Laberge, 2014, p. 419).

EXPECTED RESULTS AND FINAL THOUGHTS

A study of this type produces different results, some of which can´t be measured. It is intended that the results allows to clarify some aspects related both to technical skills learning as well as the civic training of students of predominantly technological subjects. As already mentioned, this issue has not been studied before in this particular perspective, so the results can be a starting point for further studies in this area. Furthermore, in addition to the technological learning component, there are potential consequences in the civic posture of students that will be interesting to see. Indeed, the results of this study may include aspects that are not relevant in terms of data for analysis but will be important to the education of active citizens and participants. Even if not significant in academic terms, we cannot diminish the importance of developing students awareness of their society role: "The likelihood of students becoming active citizens in

later life is increased substantially by encouraging them to take action now (in school), by providing opportunities for them to do so, and by providing detailed examples of successful actions and interventions engaged in by others" (Hodson, 2014, p. 81).

The transformation in active citizens can influence not only the role of these students in society, but also their own future development. Ferreira, Coimbra and Menezes (2012) relate the personal well-being with a significant civic participation, and the growth of a sense of community belonging as a consequence of a fair social climate. An academic community that provides incentives to young students and opportunities for participation in society will enable the emergence of a proactive and aware generation, in line with what says Hodson (2014): "It is important to note that young people are more likely to participate in community activities if a parent, some other family member or a close friend is already active and/or expresses approval and gives them lots of support (Pancer and Pratt 1999; Fletcher et al. 2000)" (p. 89). Thus, in this type of projects it should be considered that results are not always quantifiable but nonetheless important, like citizenship awareness, as referred by Sperling, Wilkinson and Bencze (2014): "As a result of our analyses, it was apparent to us that students' Action Projects had some effects on their personal orientations towards knowledge and citizenship" (p. 372). In the projects being developed by these students at this moment there is a large range of subjects, solutions and type of action. To name just a few, we can consider four projects:

- Transporte Solidário: A social transport program for elderly in west Lisbon area, under the auspices of a group of social NGOs and local authorities. The students are developing a video and web material to promote it.
- Movimento Zero Desperdício: A program intending to stop food waste and to provide quality food to those who needed it. The group of NGOs involved already served almost 1.8 million meals. The students have made musical video clips.
- Centro Sagrada Família: A day care and nursery created by a group of Irish nuns. The students are making an audiovisual communication campaign to ask for support.
- Torre de Babel: This project is not related to an external partner, being the initiative of one of the students worried about the large number of mother languages spoken in the school, without being understood by the teachers. So to improve the communication between foreign students and teachers, this concerned student created a volunteer program with foreign languages teaching, in which foreign students teach their languages to willing teachers. The program is entirely free and volunteer. The student is making an audio visual support material, to provide these classes online.

Most of these projects have also an auto-dissemination intention, trough educational meetings and social media like TV, radio and newspapers, in an effort largely made by the students. So, we have several ways of dealing with this social projects framework, in a vastly volunteer and autonomous work. It is important however not only to favor autonomous work, but to take into consideration issues that are meaningful to students, as advocated by Wentzel and Wigfield (2009, cited in Wubbels, Brok, Tartwijk & Levy, 2012), when it is said that personal objectives are motivating factors for students.

Increasing the civic participation of young people is paramount to the development of a democratic society. Since the school is one of the most important influences in youth

citizenship construction, the kind of projects studied here is essential. However, considering the educational tradition, it is not easy to include socio-political actions in the school context: “In many formal educational contexts there is still a real uneasiness associated with the political in science, technology and education. It is therefore perhaps unsurprising that science and technology education in most settings strives for a comforting ideal of apolitical, value-free practices” (Alsop & Bencze, 2014, p. 13). Azevedo and Menezes (2008), studying the relation of young students with citizenship concepts reported the existence of communication difficulties in the classroom concerning these subjects. As a matter of fact, the application of socio-political activism to education arouses strong debates between ideological views and political action, with strong arguments by the various participants in the debate. Bader and Laberge (2014), referring to the critical pedagogy and social intervention, argue that however important that may be the ideological analysis, this only makes sense if it is applied in practice, because only then will have real effects:

> Critical pedagogy also insists on reflexively naming the ideologies that orientate our worldviews. To promote social interaction in order to reduce social inequalities, we need indeed to identify some of the strongest ideologies that reinforce social inequalities. But, in order to implement some ‘praxis,’ critical thinking should also include actions. This proposal is legitimate, but makes sense only as tested in specific contexts. It is not effective if it remains ‘only’ theoretical. (p. 423)

But as controversial the topic may be, the school's role as a place of development of democratic principles, is highlighted by several authors: “a school that we envisage is an institution that seeks to not only nurture democratic participation but also more effectively represents teachers and youth’s interests within democracy: a school that is both an internal and external democratic advocate” (Alsop & Bencze, 2014, p. 15). Indeed, from the statement by Putman (1995, cited in Azevedo & Menezes, 2010) that civic engagement takes on a wide range of activities, more or less formal, in a wide variety of contexts, it is said by Azevedo and Menezes (2010) that although schools are a prime location for the development of concepts of citizenship, the experiments conducted there should be extended to the community, which fits well in the type of interactions to be studied in this work. Also Fernandes-Jesus, Ribeiro, Ferreira, Cicognani and Menezes (2011), in a study about the integration of young immigrants, gathered data that did assert that the experiences of participation in civic and political affairs were considered, by most of the youngsters, as fundamental and relevant to their living in society, revealing that people who do not perceive their rights of civic participation for granted, tend to value their social integration. Thus, the possible lack of interest that some authors refer that prevails in younger students can be somewhat faced by the participation in projects that relate to their expectations and the experience in the community where they live, as this may eventually provide reflection means about the work being undertaken and its significance for that same community.

A consequence of this type of academic projects is the development of a wish for greater involvement of students in active citizenship because as said by Ferreira (2006),

young people more involved in movements or civil society organizations reveal more prone to greater political participation. In this context, the author believes that the schools have the duty and the obligation to give students civic participation options, enabling them to learn, according to his free choice, concepts of citizenship and social solidarity. The principle should not be a mandatory participation, but rather show options, in a perspective framed by teachers, as in the present project. Indeed, although advocating freedom as a concept, poor previous experience of most students in such subjects should be matched by the teacher, translating and decoding concepts, acting as a mediator and facilitator. The association of social intervention initiatives and the programmatic subjects of technological courses, as in the present study, implies strong teacher participation in order to translate the students' social proposals into their learning needs.

Whatever the attitude of educators, education and citizenship certainly will be part of future discussions about how schools should be organized in Portugal. Monteiro and Ferreira (2011), claim that

> political education is one of the important issues faced by contemporary schools, also because its assumption of conflict helps to insure a plural and participatory democracy. This implies a democracy that challenges and interrogates, interferes with borders and repositions and is able to carry on the counter-hegemonical mechanisms we need in order to face (and conflict with) the surviving ghosts of totalitarian powers. (p. 10)

In fact, the pros and cons of this kind of actions at school generate debate, but this may itself be positive. Authors like Alsop and Bencze (2014) argue that the controversy over existing activism in the context of education can be one of the advantages: "It retains controversy in some educational circles and as a consequence invites reflection. A particular strength of the concept of activism – we suggest – is the paradox that it seems to generate concerning the locus of its educational applicability" (p. 9).

In short, beyond the technological aspects still poorly studied, the controversy generated by the activism of associating socio-political activism with education is the guarantee that this debate is alive, enhancing the need and relevance of this type of studies. More than a definitive work, what we want to achieve is providing a starting point for further studies about young students' civic capacity building issues, using technological skills acquired in school context.

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RESEARCH-BASED COLLECTIVE ACTIVISM THROUGH THE PRODUCTION AND DISSEMINATION OF VODCASTS ABOUT ENVIRONMENTAL POLLUTION IN THE 8TH GRADE

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ABSTRACT

The present research, involving a group of students from the 8th grade and the subjects of Natural Sciences and Information and Communication Technologies, had the purpose of studying the impact of the production and dissemination of vodcasts, subordinated to the theme of environmental pollution, in the perceptions of students regarding their capability for action and their development of activism skills. The construction of vodcasts by students, being usually associated with leisure and entertainment, can also be used as an activity for science teaching and learning. In this study, its production and subsequent dissemination was also used as a strategy for activism aimed at education and raising public awareness. The study followed a quail-quantitative approach, and is part of a larger investigation. The results show a positive evolution in students' perceptions regarding their capability for action, and the development of basic skills for research-based collective action.

KEY WORDS

Science education, Activism, Vodcasts.

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ATIVISMO COLETIVO FUNDAMENTADO EM INVESTIGAÇÃO NO 8. º ANO DE ESCOLARIDADE: PRODUÇÃO E DISSEMINAÇÃO DE VODCASTS SOBRE POLUIÇAO AMBIENTAL

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RESUMO

A presente investigação, envolvendo um grupo de alunos do 8.º ano de escolaridade e as disciplinas de Ciências Naturais e Tecnologias da Informação e Comunicação, teve como finalidade o estudo do impacto da construção e divulgação de vodcasts, subordinados ao tema poluição ambiental, nas perceções dos alunos relativamente à sua capacitação para a ação e ao desenvolvimento de competências de ativismo. A construção de vodcasts pelos alunos, estando, geralmente, associada ao lazer e entretenimento, pode também ser utilizada como atividade de ensino e aprendizagem das ciências. Neste estudo, a sua construção e posterior divulgação foi também utilizada como estratégia de ativismo visando a educação e sensibilização dos cidadãos. O estudo, centrado principalmente numa abordagem mista, é parte integrante de uma investigação mais ampla. Os resultados evidenciam uma evolução positiva nas perceções dos alunos quanto à sua capacitação para a ação, e o desenvolvimento de competências fundamentais para uma ação coletiva fundamentada em investigação.

PALAVRAS-CHAVE

Educação em ciência, Ativismo, Vodcasts.

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Research-Based Collective Activism Through the Production and Dissemination of Vodcasts About Environmental Pollution in the 8th Grade[1]

Ana Rita Marques | Pedro Reis

SCIENCE EDUCATION AND ACTIVISM

Education can be defined as a socialization process through which each individual is primed to assume an active role in society (McMannon, 1997; Shor, 1992) through the development of skills that allow for an active civic participation, through promoting citizens' empowerment. Education for empowerment – being participative, affective, problem based, situated, multicultural, dialogical, democratic, research based, interdisciplinary and activist – allows students to became part of a capable working force, thinking citizens, and even more, social critics and change agents (Shor, 1992). The probability that students become active citizens in the future increases substantially if we encourage them to act now, in the present, creating opportunities for them to do so, and giving them examples of successful cases and of interventions carried out by others (Hodson, 2014).

It's urgent to educate citizens that are able to face the different problems that permeate current societies, most of them highly controversial and representing threats to the well being of individuals, societies and environments. Facing these problems requires understanding them, making decisions and acting (Reis, 2013, 2014). Nevertheless, this role does not belong exclusively to adults. Expecting today's students to grow up and became the adults of tomorrow, and then demand them to make decisions and to act when confronted with social and environmental challenges is wasting valuable (and unrepeatable) opportunities to educate today, in our schools, conscious citizens of the need to participate in civic life. Students can, and should, be regarded as being part of the solution of current problems (Jensen, 2002) and for that, Science Education will be crucial to empower them to take on this role. Yet, the prevalence of a science education model almost exclusively established on the positive products of a well established science with few controversies and questions (Bell, 2006), of a decontextualized, prescriptive and impersonal teaching tradition (Bencze, Sperling & Carter, 2012) where students play a passive role, resulting in their disinterest (Roth, 2001), contributes very little to the development of active citizens, participative in the resolution of socio scientific and socio-environmental problems (Jensen, 2002). Even more, it prevents students from expressing their opinions and creativity, and developing an active participation, where they learn to build and achieve compromises, and in that way coming to understand that their voice can influence what happens to them and to the world around them (Figueiredo, 2002).

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If we aim for a curriculum oriented to sociopolitical action (Hodson, 2013) students' learning must be much more than the simple acquisition of science content and concepts, and be organized around problematic issues such as: human health; earth, water and mineral resources; food and agriculture; energy resources; consumption levels and sustainability; industry; transport and communication technologies; and social and ethical responsibility (Hodson 1994, 2003, 2014). The teacher's approach must have in mind the four levels of sophistication that we want students to achieve: (i) assess the social impact of scientific and technological transformations, understanding that science is a product of its time and place, and that it can rapidly change the way people think and act, (ii) recognize the existence of economic interests influencing scientific and technological decisions, (iii) formulate opinions about important questions and establish positions around certain values, and (iv) prepare for sociopolitical action, meaning, for a responsible action in favor of the environment and society. According to Hodson this last level is the one that will allow students to actively take part in the decision making process. This author believes that the concept of scientific literacy must be amplified, also taking into account the sociopolitical dimension (Hodson, 2011).

Whatever the selection criteria taken into account, for the choice of the problematic issue guiding the students' action, they will need scientific knowledge if we expect them to get involved past a superficial level. Substantive knowledge, guided towards action, is crucial to understand the issues underlining the problem, to assess different stances, and to make informed decisions and arguments (Hodson, 2014; Jensen, 2002). It is this scientific knowledge, resulting from students' lead research that distinguishes the collective activism introduced by authors such as Derek Hodson, from common sense. But besides this knowledge, for Jensen (2002) there are three other levels for involvement in sociopolitical action: (i) knowledge about the social, political, and economical questions related to the issue and how they contribute to the emergence of social and environmental problems, (ii) knowledge of how to promote change in society through direct or indirect actions and, (iii) knowledge about the probable result or direction of possible actions, and the need for such results. We can easily conclude that students must learn how to participate, and experience participation in action (Hodson, 2013). But to learn about action, through action, and from action are different things (McClaren & Hammond, 2005), even though equally necessary to warrant the involvement and commitment of the students in research based collective action (Hodson, 2003). Learning about action has the goal of developing skills and action strategies; providing students with examples of successful actions, preferentially with other students, fuels their belief that they can also change things. Learning through action includes the direct engagement in action oriented projects outside the classroom that will probably have concrete and consequential results. To learn from action happens when students evaluate plans, strategies, processes and the results of their action projects. This is a reflexive and evaluating process that combines a register of what happened or of what the students perceived, in an attempt to explain why, reflecting about the meaning of the action for themselves and the community.

The students involvement in sociopolitical action about socio scientific and socio-environmental controversies allows them to increase (a) their knowledge about these questions, (b) their research and citizenship skills and, eventually, (c) the well-being of individuals, societies and environments (Bencze & Carter, 2011; Roth & De'sautels, 2002). But how can we warrant the students' personal investment and commitment for

the resolution of problems and for action? For some authors the answer requires, in first place, their emotional investment (Hodson, 2014; Littledyke, 2008). This may be accomplished when issues that have a small impact on their lives, are distant to them and have a weak emotional connection start to be perceived as real.

For Schalk (2008) the students' involvement in activism initiatives promotes (a) critical thinking skills, through multifaceted problem solving; (b) communication skills through the need to share arguments that sustain the importance of the initiated action; (c) creativity, in virtue of the need to develop effective initiatives in certain contexts or situations; (d) perseverance, through the understanding that the change will not be done immediately, being that most of them will not be visible in the near future and/or will not be recognized by others; (e) empowerment, from the moment that the students' realize that their actions, even in the absence of authority, allow them to make a change.

In a school setting there are several possible strategies where students and teachers can become involved in direct and indirect sociopolitical action about environmental issues, namely through: 1) the organization of pressure groups responsible for (a) writing and distributing letters and petitions for political powers or other institutions and (b) through the boycott of certain products resulting from socially controversial research or industrial practices; 2) through education initiatives for other citizens with the purpose of promoting a change in behavior; 3) volunteering in initiatives that promote a fair and ethical society; 4) proposing innovative solutions for local and/or global problems; and 5) changing their own behaviors (Hodson, 2014; Reis, 2013). The development of multimedia resources, such as vodcasts, can be part of an educational strategy in support of other citizens.

VODCASTS IN SCIENCE EDUCATION

The term vodcast can be used to refer to video content, generally made for computers or others digital media (Meng, 2005). The prefix vod is based on the expression video on demand, and it implies the capture of video through a camera. The creation of vodcasts can make use of video cameras, digital photography cameras, or even tablets and smartphones – tools that allow the capture of videos which can afterwards be edited. Vodcasts can also be built through combination, animation, and transition of static images interspersed by video excerpts, sound and narration. There are many tools availableor the development and edition of vodcasts, as for example MovieMaker, iMovie and Corel VideoStudio among others. Although they have different attributes – more or less complexity and diversity of functions- it is possible to create quality videos even with very simple applications.

The construction of vodcasts/videos by students, generally associated with leisure and entertainment, can also be used as an activity for teaching and learning science (Serafim & Sousa, 2011), resulting as highly motivating for students and advantageous for the teaching and learning process (Almeida, Rezende & Lima, 2012; Hilton, 2011; Karahan, 2012; Menezes, Kalhil, Maia & Sampaio, 2008; Roehrig, 2015; Vargas, Rocha & Freire, 2007). Engaging with content through the development of vodcasts challenges the students – allowing them to learn more easily through the use of different

technological and cognitive resources during the systematization and the application of knowledge (Almeida, Rezende & Lima, 2013; Serafim & Sousa, 2011). Producing a vodcast targeting environmental issues promotes the development of a reflection process as well as the construction and negotiation of meaning. It is also a learning opportunity where content is engaged with in a pluri-dimensional manner– conceptual, procedural and attitudinal (Almeida, Rezende & Lima, 2013). Independently of the project topic the production of vodcasts by the students can be regarded as a practice that allows them to explore issues resulting from the displacement of students' passive role – as a receiver – towards being an active participant, simultaneously as receiver and producer (Karahan & Roehrig, 2015; Pereira & Filhos, 2013).

There are few studies about the impact of production and dissemination of vodcasts in students activism learning and skills development – international studies are mainly focused on the analyses of the impact of vodcasts' visualization on students learning, with vodcasts being mainly regarded as learning objects (Gkatzidou & Pearson, 2007) or as tools to be used by the teacher (Brown & Green, 2008). There are even less studies dealing with the production of vodcasts/videos as an activism strategy enacted by students.

In 2012 there was a study done in a Higher Education context (Cotner, Kleinschmidt & Kempnich, 2012) in a General Zoology course, where students had to create a small vodcast related with the course topics that were assessed regarding their ability to communicate the scientific topics. The students used different tools to build the vodcasts, such as Prezi, Keynote, Powerpoint, Quicktime, Windows, Movie Maker, iMaker, and others. According to the authors the project allowed the students to develop a) a substantial knowledge about the course topics; b) communication skills; and c) a better understanding about how scientific knowledge improves.

McDonald and Hoban (2009) led a research project where science teachers in training developed and disseminated through a website the produced artifacts with the goal of representing complex and abstract scientific concepts (in the form of slow-motion animation). This research concluded that not only were teachers able to acquire knowledge related to the studied concepts, but also that the sharing of the produced artifacts was highly motivating, prompting them to invest even more in this task.

Hilton (2011) carried out a research project to evaluate the potential of video productions made by 7th grade (between the ages of 11 and 13) English students for science learning. In this study two classes worked on the same topic - in one of them the students produced a video, in the other a poster. Both artifacts would be used to raise awareness and teach other students. The author came to the conclusion that the students that produced the video where more involved in their task, collaborating more effectively and demonstrating increased concern about the understanding and explanation of the underlining scientific concepts.

Karahan and Roehring's (2015) research intended to evaluate the impact of the construction and dissemination of artifacts (videos) on science students' ability to be alert and act when faced with environmental issues. The students produced videos that reflected their knowledge, attitudes, awareness and activism about environmental issues. The artifacts were then shared and disseminated making use of a website made for that purpose, through which the students could also communicate with visitors. The authors concluded that the students' awareness and capacity for activism where developed in the artifact construction and sharing process, with a positive impact on their motivation and engagement.

METHOD

The study followed a quail-quantitative approach, and is part of a larger investigation developed in 2013 in an 8th grade class with 30 students in a Cascais area school (Lisbon, Portugal), with twenty two girls; with an average age of thirteen at the beginning of the school year. Framed by a logic of interdisciplinary work, the study included both the Natural Sciences (NS) and the Information and Communication Technologies (ICT) subjects, and their respective teachers, with the NS teacher also acting as a researcher in the project. Given the fact that these students displayed little autonomy and were not used to project work, the environmental activism initiative was prompted, initially, by the teacher. The topic to be addressed and the final products to be shared with the school community were chosen by the students: vodcasts focusing on environmental pollution aimed at being disseminated to the general public. The content of each vodcast was also chosen by the students, working in pairs.

We followed McClaren and Hammond's (2005) recommendations, developing different activities with the purpose of allowing students to learn about action, through action and from action. After an initial raising of alertness to the chosen topic through the use of impacting images, previously selected and organized by the teacher, with the goal to motivate students for action, they were questioned about what they could do to help stop environmental pollution. From this question was then developed the learning about action dimension, through the presentation and discussion of several activism initiatives, some developed by non-governmental organizations, such as Greenpeace, and others developed by other students. By virtue of the participation of the ICT subject the students showed their willingness to develop awareness raising videos for the different issues related with environmental pollution – activity that they had never done before and for which they showed great initial enthusiasm.

The students chose and investigated the subtopics – ocean pollution, fresh water pollution, air and ground pollution – in order to acquire knowledge allowing them to develop the vodcasts, working with peers in the ICT subject. There were fifteen work peer groups: even though some of them worked on the same subtopics of pollution, the aspects that were approached were different. The vodcasts were then presented in promoting sessions conducted by the students, where older students from other classes were present, and posted in the school website.

The video editing software used was Corel Video Studio – a previous lesson of ninety minutes was needed to show the students how it functioned, allowing them to work with it. In this same lesson the students were also informed of the assessment criteria and about the characteristics the vodcasts should have: a clear message, objective and intended impact, a minimum of 2 minutes, include narration, at least one music excerpt, images and videos. The students were warned of the need for coherence between the different video elements. The teacher selected three videos from YouTube to exemplify to the students the aspects that they should consider: one of them was from the non-governmental organization Greenpeace, about ocean pollution, and two others made by 8th grade students about pollution – one of was used as a bad example not to follow due to bad narration, the overuse of text, and the excessive use of different musical excerpts with different volumes.

RESEARCH GOALS

The main goal of the research was to study the impact of the construction and dissemination of vodcasts, on the topic of pollution, as a strategy for research-based collective activism. The research was guided by the following sub questions:

1. What perceptions do students develop regarding their capability for action?
2. What activism skills do students develop?
3. How do students rate the vodcast construction and dissemination activity, and its impact as an activism strategy?

In order to evaluate the impact of the project on students' perceptions about their capability for action, a pre-post questionnaire was used, both in the beginning and at the end of the project, composed of 12 items, rated according to a Likert type scale, in which students would have to indicate their degree of agreement (totally in disagreement, partially disagreement, partially in agreement, totally in agreement). The questionnaire used was developed within the framework of the project "We Act - Promoting Collective Activism on Socio-Scientific Issues" (Reis, 2014a, 2014b) and validated by its application to the 947 participants of this project. The internal consistency of this questionnaire was evaluated through the Alpha Cronbach test, having obtained a value of 0.804 which is considered good. The software SPSS version 22 was used for the statistical treatment of the collected data. The time elapsed between the pre- and post-test was 3 months. The comparative statistical analysis of the results in the two moments was performed using a non-parametric test (Student's t-test, with 95% of confidence level) for paired samples to evaluate the existence of statistically significant differences between pre-test and post-test responses. The Anderson-Darling test was previously performed to ensure that the samples were homogeneous and responded to normal distribution.

Evaluation of activism skills was based on classroom observations – a process guided by observation grids with a descriptive type scale, on the results from the pollution questionnaire (pre and post-test), on the final summative test, on the students' productions (vodcasts) and on students' performance during the dissemination sessions. The students' perceptions regarding the production and dissemination of the vodcasts were evaluated using an open-ended questionnaire implemented at the end of the project; these answers were subject to content analyses, with the results being counted as both absolute and relative frequencies. In order to illustrate them some examples of the students' perceptions were selected.

RESULTS AND DISCUSSION

WHAT PERCEPTIONS DO STUDENTS DEVELOP REGARDING THEIR CAPABILITY FOR ACTION?

From the analysis of table 1, it is possible to verify the statistically significant differences (values under 0.05) between the results of the pre and post test for all items except 1, 6 and 7. In order to facilitate the results analyses, the 12 items of the questionnaire were grouped in 4 separate domains: (i) recognition of the involvement in initiatives that contribute for solving social and environmental issues – items 1 and 2; (ii) recognition of the importance and the obligation to participate and develop initiatives that contribute to solving social and environmental issues – items 8, 9 and 10; (iii) recognition of the ability to develop initiatives that contribute to solve social and environmental issues – items 3, 4, 5, 6, and 7; and (iv) knowledge of strategies and resources for the development of initiatives for solving social and environmental issues – items 11 and 12.

The attained results show, to a great extent, a change in students' activism perceptions after the development of the vodcasts production and dissemination project about environmental issues. Concerning the recognition of the involvement in initiatives that contribute for the resolution of social and environmental problems domain (items 1 and 2) the students already started with a perception of being involved in such initiatives, contributing for the resolution of social and environmental issues, but they didn't recognize such involvement in their peers – this situation was reversed at the end of the project.

In the domain recognition of the importance and the obligation to participate and develop initiatives that contribute for solving social and environmental problems (items 8, 9, and 10) the experience in the project caused a significant change in the students' perceptions. If in the beginning the students showed some doubts as to their obligations to participate in initiatives of this nature, at the end of the project they dissipated.

Concerning the domain recognition of the ability to develop initiatives that contribute to solve social and environmental problems (items 3, 4, 5, 6, and 7) we verified some very interesting improvements, especially as far as their perception of ability and feelings of empowerment to influence others decisions, individually or as a group, are concerned. At this level, the project had a very positive impact, contributing to raise the students' self-esteem and capacity for action. In items 6 and 7, it can be seen that students' start out from a situation where they perceive themselves as being capable of researching and making decisions about problems related with science, technology and the environment.

Finally, in the domain knowledge of strategies and resources for the development of initiatives for solving social and environmental issues (items 11 and 12) there were also significant differences between initial and final results. In the beginning students didn't believe that they had the resources to start up activism initiatives, and showed uncertainty about the knowledge to carry them out. Nevertheless, their experience in the project and in the different learning situations allowed them to reverse these perceptions.

Table 1

Comparing the results attained in each questionnaire question about activism perception in the pre and post- test (p<0,05).

Items	**Difference between pre and post-test**
1. I get involved in actions/initiatives with the goal to contribute to the resolution of social issues that worry me.	0,083
2. My colleges get involved in actions/initiatives with the goal to contribute to the resolution of social issues that worry them.	0,011
3. I'm able to influence my colleges in their decisions about social issues related to science, technology, and the environment.	0,022
4. I have the power to influence other citizens' decisions about social issues related to science, technology, and the environment.	0,005
5. If I collaborate with my colleges, we have the power to influence other peoples' decisions about social issues related to science, technology, and the environment.	0,005
6. I know how to research information about social issues related with science, technology, and the environment.	1,0
7. I'm able to make decisions about social issues related to science, technology, and the environment.	0,327
8. I think I have the obligation to participate in activities/initiatives that will benefit the community that I live in.	0,022
9. I think I have the obligation to participate in activities/initiatives that will contribute to the resolution of global/world issues.	0,006
10. I have the obligation to participate in activities/initiatives that contribute to the resolution of local issues in the community that I live.	0,022
11. I feel that I have the resources to set up initiatives that will contribute for the resolution of social issues related to science, technology, and the environment.	0,002
12. I know ways to influence citizens' decisions about social issues related with science, technology, and the environment.	0,001

WHAT ACTIVISM SKILLS DO STUDENTS DEVELOP?

In this study activism skills were understood as those that contribute to research-based collective action (Hodson, 2014). This way, taking into account Schalks (2008) proposal, we tried to evaluate the existence and the development of skills of a) substantive knowledge about the topic, b) communication, and c) attitudinal through the developmental of several learning situations leading towards the production and dissemination of the vodcasts.

Substantive knowledge skills

The evaluation of the existence/development of substantive knowledge skills about pollution was assessed taking into account the results from the questionnaire (pre and post), the final end of project summative test, and the analysis of the vodcasts produced by the students.

The questionnaire about pollution – developed taking into account the main alternative conceptions the students tend to have related with the topic of pollution – was composed of 40 true or false items. This instrument was used with two goals: to evaluate the students' initial knowledge; and to evaluate the project's impact on the students' capacity to acquire substantive knowledge about the selected topics. For these reasons it was applied in the beginning and at the end of the project. The initial results were not shared with the students, answers were not corrected, the questionnaire was not returned, and they were not informed that they would answer the questionnaire again at the end of the project. Average questionnaire scores, pre and post-test, were 70% and 85%, respectively, showing that the students were able to develop substantive knowledge about the selected topic. However, the chosen typology of question was not free of casual answers – this is an inherent risk in this type of questionnaires that try to classify a proposition's logical value (true or false).

The students completed a final summative test, which was also about the topics studied during the project (ocean pollution and oil spilling; air pollution, global warming and ozone layer; ground pollution; changes in ecosystems' balance). The final average of 72% (standard deviation of 13, 4) shows that, in general, they were able to develop and muster knowledge related with the topics researched for production of the vodcasts.

The produced vodcasts were assessed taking into account their scientific accuracy: it was considered that the presence of scientific inaccuracies – concepts and information scientifically inaccurate or inadequate to the context – either in the narratives or other elements of the vodcast was a reflection of an inadequate construction and/or mobilization of knowledge about the topic. In this domain, all the groups developed a product that, from a scientific standpoint, presented no inaccuracies. This was a result of the previous research and discussion of the concepts, studied in the NS subject, but also the need to elaborate, in the ICT subject, a product that reflected the students' knowledge about the topic, and allowed others to learn from it.

Communication Skills

The evaluation of the existence/development of communication skills was assessed from the observation of the students' performance during the vodcast sharing and dissemination sessions. An important dimension in this skill domain is the use of ICT to communicate ideas. In fact, most of the groups (14; 93%) finished the novel task of constructing a vodcast, allowing other students the opportunity to learn about and experience a new way to communicate their ideas – even if there is still room for improvement that will most certainly result from an intensified use of these types of resources. The students' skills to communicate their ideas creatively through vodcasts was also assessed: it should be emphasized that some videos were more creative than others, being that many students followed primarily their personal taste in the selection of the video elements (music, graphical outlook) that didn't always contribute to the desired impact. However, the students' insufficient knowledge about the video editing software potential and functions hindered the students' creativity. Moreover, the fact that this was their first experience producing a video also limited their creativity. For the students this was a creative video, given that it was the first one ever that they produced – representing something innovative and original for themselves.

In the dissemination sessions, the working groups have had to present their vodcasts and answer to questions posed by the audience (teachers and senior students from other classes). In general, the students showed confidence and ability to argue, presenting the products of their work with clarity and objectivity – to which contributed their knowledge on the subject – and defending with conviction the positions taken in the vodcasts they developed.

Attitude and collaborative skills

The evaluation of the attitude and collaborative skills necessary for productive group work, supporting the development of the activism project, and consequentially the production and sharing of the vodcasts, was done systematically throughout the classes devoted to the planning and construction of these artifacts, allowing for the assessment of the students' progress during a month and a half. This evaluation was carried out by making use of an individual observation grid with a descriptive scale, operationalized with four performance levels for each of the five domains assessed: a) Commitment in the tasks; b) Accomplishment of the tasks; c) Conflict resolution; d) Autonomy; and e) Time management. As an example, for the Time management domain, if the students´ didn't manage their time properly, and for this reason failed a deadline, they would get a score of 1; if the students´ often delayed their tasks, they would get a score of 2; if they were able to complete the task but could not respect the deadline, they would get a score of 3; lastly, if they were able to effectively manage their time finishing the tasks within the deadline, they would get a score of 4.

For the assessment of the students' progress in each of the domains, we took into account the global average score, per domain, in the ICT classes dedicated to the vodcasts development (figure 1) – from its analyses it is possible to observe that there was a global positive progress in all domains.

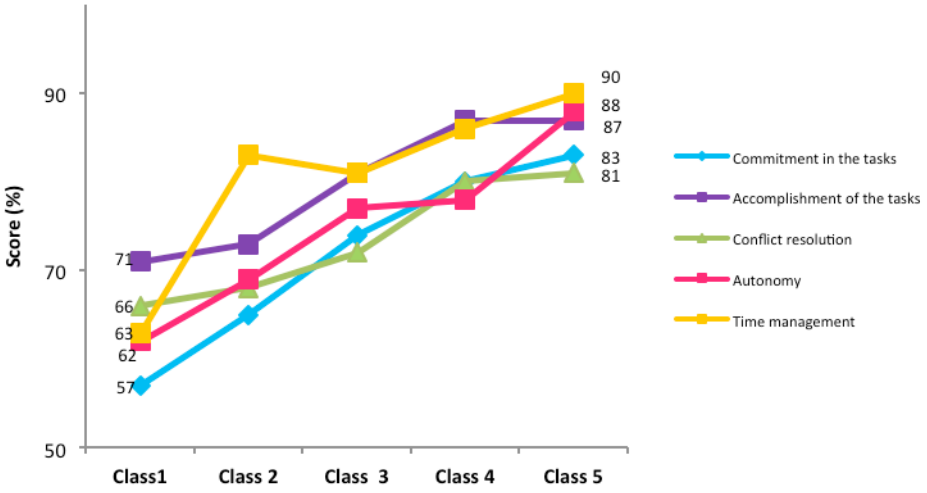

Figure 1. Students' global average scores (in %) in each of assessed domains in the ICT classes. These scores were attained from the individual students' scores per domain. A group score per class was then calculated, and finally the average scores for all class groups.

In general, the students´ were able to complete their tasks with commitment, contributing with ideas, and effort in a positive way – the average global score increased from 57% to 83%. Regarding the accomplishment of the task dimension – that intended to assess the students´ ability to carry out, in a responsible manner, their roles in the group without being warned – even though the results show that from the beginning the students demonstrated good capacity to fulfill the tasks in a responsible manner, they were able to improve it (from 71% to 87%).

Considering the domain conflict resolution – in which we intended to evaluate the students' capacity to effectively prevent or solve conflicts with their group partners – the results show that most students, in the beginning, were not tendentiously conflicting and/or were able to successfully resolve conflicts (increasing from 66% to 81%). In the autonomy domain – where we intended to assess the students' ability to autonomously complete their tasks, without the constant need of help and support from their teachers, only requesting it after exhausting all their problem solving strategies – the results highlight that the students', in general, acquired and/or developed a very good capability to perform the tasks autonomously, relying mainly on their peers, instead of asking for the teacher's support. The global average score increased from 62% to 88%.

As far as the time management domain is concerned – through which it was intended to evaluate the students'/groups capacity to concluded the tasks in the deadline estimated avoiding any delays – the results showed that the students not only

revealed good time management skills from the beginning, respecting deadlines, but also that those that did not have this skills to start with, seem to have been able to develop them. The global average score increased from 63% to 90%.

HOW DO STUDENTS RATE THE VODCAST CONSTRUCTION AND DISSEMINATION ACTIVITY, AND ITS IMPACT AS AN ACTIVISM STRATEGY?

As far as the dissemination sessions are concerned, the open-ended questionnaire analysis revealed that all the students (27; 100%) considered important that their colleagues (from their class, other classes, or older) could watch their videos, for the following reasons – several students supported their view with more than one argument. Students valued mostly: a) the fact that they could learn from their colleagues' criticism; b) the fact that they could learn more about other topics; c) being able to teach the topics to their colleagues; d) perceiving the impact of the vodcast on others; e) being able to understand if their vodcasts were able to convey the intended message; f) the opportunity for older students to alert others and help spread the videos. These perspectives can be illustrated by the students' answers to the question "Was it important for you that your classroom colleagues, as well as colleagues from other classes, could watch your video? Why? ":

> Yes, it was important because when we shared the videos, we could get comments and critics from our colleges, and understand, from each group, the video's impact (S);
>
> Yes, because this way we know what they thought about our video and we managed to get the message to other people. (M);
>
> It was important because I wanted to know what the other colleagues thought about the video, that Martim and I made, and if they were going to understand the message. (CI);
>
> Yes. Because this way we could find mistakes and help each other. This way we could learn, about pollution, as well as how to fight it. (D);
>
> Yes, because they learned more things about pollution and learned what they could and what they couldn´t do. (V);
>
> Yes, it was important because they didn't know about the subject, and in that way they can say if the video properly conveyed the message, and if they understood what it was about, and what we can do to improve it. (T);
>
> Yes, first to share the video, and secondly I wanted to see what was the impact that our videos had on them. (Ma);
>
> Yes because it's more people to share the video. (A).

All the students' considered important sharing the vodcasts with their family, friends, and other people. This feature is emphasized by the answers given by the students, grouped in five categories – learning, behavioral change, display of work done, knowing other people's opinions, dissemination help (figure 2). There were situations where students used more than one aspect to support their answers – for that reason there was a total of 32 occurrences. The argument that dissemination of the video can lead other people to learn more about the issues and thus pollute less (learning category) accounted for half of the occurrences (16; 50%); on the other hand, dissemination can also lead to a change in behavior (behavioral change category) – an argument presented in seven occurrences (22%); the importance of dissemination is also related to the fact that the students can share the results of their project work with others (display of work done category; five occurrences; 16%) ; two students (6%) mentioned that they can learn about others opinions about their work (knowing other people's opinions category); two students (6%) believed that other people can contribute to the dissemination of their videos (dissemination help category). The following answers illustrate these perceptions:

> Because our videos have the goal to alert people to the consequences of pollution, and the more they're shared the better! (MA);
>
> Because they learn what pollution is, and can see my 2nd term work in the science and ICT subjects. (Am);
>
> I think it's important because when sharing with others they can learn and change their attitudes and not pollute the world. (J);
>
> This way we can know what our family thinks about the video, and they can share it with others. (S).

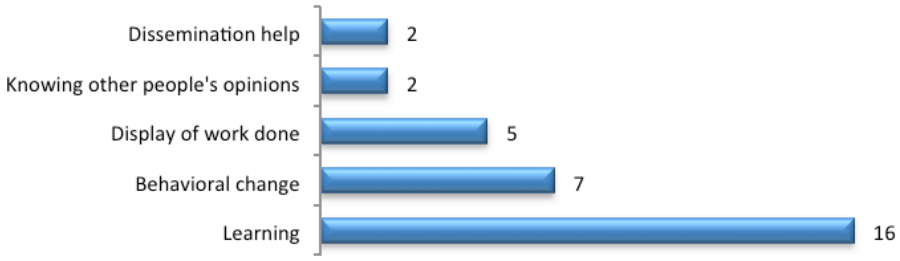

Figure 2. Results from the question "Do you think it's important to share (disseminate) your video with family, friends, or other people? Why? " from the final questionnaire; n =32.

Based on these results it seems possible to infer that the students recognize the importance of disseminating their work – such a finding represents an important step for an activism initiative aiming to contribute to the education and awareness of others.

The results attained from the analyses of the answers to the questions "Do you think that your video, and those of your colleagues, may have some impact on others, leading them to change their behaviors and pollute less / or to be more alert to the issues of pollution?" and "Do you think that with this project you were able to change, even if only slightly, the society in which you live in? Why?" reveal optimistic and confident students. Most students (25; 93%) consider possible that their videos have an impact on others changing their behaviors and/or raising their awareness to pollution issues – only two students (7%) indicate having doubts about this possibility:

> I think it will have impact, but do not know if they will do anything to change pollution, at least they will be more aware and more informed about pollution and its consequences. (R);
>
> I think so, a little, if the videos were disseminated. But I don't know if people would change their attitudes. (AL).

Two examples of more optimist student testimonies are:

> Yes, indeed. I believe our videos were very enlightening and can have an effect on people not to pollute. (S);
>
> Yes because we are "children" and we changed our attitudes, so I think people may change their attitudes as well. (C).

Regarding the second question, most of the students (20; 74%) believed that, with the developed project, they managed to change, even if just a little, the society they live in – the arguments used are: a) people learned more about pollution; b) people will, from now on, have better care; c) the videos had an impact on others. Testimonials:

> Yes; I even think people were shocked when they saw my video; but I think they will be able to alert and change society. (MN);
>
> I think so, because I can already see the little pieces of paper that people throw in the air and then I think what if thousands are doing the same! Then I tell them to pick it up. (C);
>
> Yes because if all people that watched the video stopped polluting, society will change a lot and for the better. (AM).

Four students (15%) consider that, in spite of the developed project, they failed to change the society they live in, given that they still did not have a chance to share their video – this implies that, if they share it, they will manage to do it.

Three students (11%) do not know if the project they developed was able to change society around them, explaining that there are people who do not care about these topics, or the fact that there are already so many videos on the internet, and yet the world does not seem to improve.

Considering the answers to the question "What seems to be the best way to disseminate your video?" from the final open-ended questionnaire, students mentioned different strategies, five of which directly involve using the internet: through social networks, or posting on the school website. Gathering the family at home and sharing the video when they are all together, was a strategy mentioned by several students. In fact, most of the suggested strategies are easy to implement – and since most students, according to the field notes, have access to social networks, having a profile in at least one (primarily Facebook), the possibility of dissemination in such manner is entirely up to them. The following testimonials illustrate the above:

> I think that the best way to disseminate is sharing it, like I did, on Youtube. (R);
>
> On Youtube and other social networks, and also at home for the family to see. (M);
>
> I think the best way to do it is through Facebook because there are millions of people who use Facebook (V);
>
> Spread the word and maybe ask my parents to share the videos (for example by talking with their colleagues or friends). Disseminate in other social networks. (C).

FINAL CONSIDERATIONS

The present study intended to engage a group of students in an environmental activism initiative through the production and dissemination of vodcasts about pollution for the citizen's awareness and education. It is the authors' belief (and hope) that regarding and empowering students as citizens of the present, encouraging them to act, as the driving force of the project, will increase the likelihood that they will continue to be active citizens in the future, capable of facing controversial issues, many of which are related to Science, Technology, Society, and the Environment, assuming compromises and realizing that their voice may have influence on what happens to them, and on the world around them (Figueiredo, 2002; Hodson, 2014; Jensen, 2002).

The project was organized around the topic chosen by the students – pollution – which is part of the science curriculum. The option for the production of vodcasts was also the students' choice, motivated by novelty of the task, by the possibility of using the computer, and by the use of the internet to disseminate their work. The chosen topic is broad enough, and the different issues addressed included some of the topics referred by Hodson (1994, 2013, 2014) as problematizing to be included in an action oriented curriculum. Given the fact that action oriented, substantive knowledge, is crucial to understand the underlining aspects of the problems, evaluate different positions, make informed decisions and arguments (Hodson, 2014; Jensen, 2002), one of the students'

focus was precisely the task of research and knowledge development on the various subtopics, essential for the vodcasts production. It is this type of scientific knowledge resulting from research carried out by students that distinguishes research-based collective activism from the one driven by common sense only (Hodson, 2014).

It is important to emphasize that this was the very first activism project in which this group of students participated. This was a group of students little or nothing used to play an active role in the classroom (and school), accustomed to an essentially transmissive teaching model in which the teacher rarely delegates in them the tasks of choosing which subjects to investigate, what actions develop (and how), and what products to design in order to implement them. These students were little or nothing accustomed to the methodology of project work, so a closer orientation was required during its development, especially in its early stages. It was with some surprise that students saw the teacher questioning them about what topics they would like to investigate and why, what products they would like to develop, and how they could spread what they had learned so they could alert other citizens. However, the students embraced with enthusiasm and perseverance the different tasks of the project. And when it was completed, the students were proud of the fact that they were able to contribute little, if anything, to alert others to a subject they considered current and important.

A fundamental dimension of any activism process is the recognition of the capability for action, taking into account its different sub-dimensions, including the recognition, by the individual, of the importance and duty to participate in activism initiatives, recognition of the capacity to develop them, and the knowledge of the means to carry them out. This study evaluated the improvement of the students' perceptions on these sub–dimensions, with very positive results, showing that participation in the project had a significant impact on the development of the students' capability for action. The students were able to learn how to participate in action – learning about the importance of research, the need to create a product and its dissemination – but the opportunity to experience participation in action was crucial for the development of their perceptions. We recall Hodson (2014) who argues that students should not only learn about how to participate, but should also experience participation in action.

The fact that they experienced participation in action allowed students to develop some key skills for the exercise of research-based collective activism (Schalk, 2008): a) construction and mobilization of substantive knowledge on the topic of pollution; b) communication of their ideas through the production of vodcasts; c) arguing of critical questions presented during the dissemination sessions; d) commitment, fulfillment of tasks, conflict resolution, autonomy and effective time management.

Realizing that learning about action, through action and from action are different things (McClaren & Hammond, 2005) but essential for the empowerment for action, we aimed to engage students in tasks that stimulated this learning. During the project introduction session, they had a chance to learn about examples of successful actions involving other students; during the research tasks, as well as the production and dissemination of vodcasts, they had a chance to get directly involved in a project–driven action; and through the final questionnaire they could reflect on the (perceived) meaning of action for others and for themselves. Nevertheless, we consider that this last reflective dimension, which promotes learning from action, could have been better explored. For example, with the development and implementation, by the participating students, of a questionnaire to the students who were present during the dissemination sessions, allowing them to learn about their

perceptions concerning the vodcast messages, its impact, and the possibility of behavior change after the visualization would have been very useful, and the results could contribute to an enhanced reflection about the meaning of the action. Enabling the possibility of commenting on the vodcasts posted on the school website could also provide the students with some feedback for improved reflection. These aspects should be taken into consideration when implementing further projects of this nature.

From the students' answers to the final questionnaire, it is possible to conclude that the dissemination sessions represented the highlight of the project, not only because they allowed them to find out their colleagues perceptions about the vodcasts (message and impact), but also by the sense of pride and satisfaction with the conclusion of an unprecedented project. The answers, in general, reflect optimistic students that believe in the dissemination of the vodcasts, and know how to do it; they also portray confident students about the impact that their actions can have in society. Finally, we reiterate the need in future research for a more thorough assessment of the impact – with more consistent feedback from the audience – in order to avoid creating in the students the illusion that these actions are always successful, stimulating feelings of perseverance, understanding that the desire changes will not happen immediately or may not even be recognized by others (Schalk, 2008).

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Citizenship Education in Nanotechnologies as a Means of Developing Ethical Thinking Among Students

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ABSTRACT

As pertains to the didactics of SAQs (Socially Acute Questions), we have experimented with educational devices contributing to the development of (i) controversial questions, (ii) engagement abilities and (iii) ethical thinking among learners. The work described in this paper has a praxeological aim. The combination of several theoretical fields related to nanotechnologies (nanoethics, sociology and political science, political philosophy) and their evolution during the past several decades, enables us to point out the lacunae and deficiencies that need to be addressed in order to build a citizenship education around this issue. Care Ethics provides some elements for building practical pedagogical devices capable of contributing to the development of hybrid, cosmopolitan and ethical thinking among—and even the empowerment of—learners. These elements can then be used as a guide for engineering debates and moral questioning on an SAQ related to nanomedicine.

KEY WORDS

Socially Acute Questions (SAQ), Citizenship education in nanotechnologies, Ethics of care, Ethical thinking.

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EDUCAÇÃO PARA A CIDADANIA EM NANOTECNOLOGIAS: DESENVOLVIMENTO DO PENSAMENTO ÉTICO DOS ESTUDANTES

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RESUMO

No campo da didática das Questões Socialmente Vivas (QSV) experimentamos alguns dispositivos que contribuem para questões controversas, para as capacidades de envolvimento dos cidadãos e para o desenvolvimento do pensamento ético dos alunos. O trabalho descrito neste *paper* tem um objetivo praxeológico. O cruzamento de diversos campos teóricos relacionados com as nanotecnologias (a nanoética, a sociologia e as ciências políticas, la filosofia política), e sobretudo a sua evolução nos últimos 15 anos permitirão identificar as lacunas e deficiências necessárias para construir o pensamento em torno do tema da educação para a cidadania. As contribuições da ética do cuidado possibilitarão a construção de dispositivos pedagógicos práticos capazes de contribuir para o desenvolvimento do pensamento ético entre os alunos, assim como para a sua capacitação. Estes elementos poderão, então, ser utilizados para orientar a engenharia dos debates sobre QSV moralmente relacionadas com a nanomedicina.

PALAVRAS-CHAVE

Questões socialmente vivas, Ética do cuidado, Educação sobre as nanotecnologias, Pensamento ético.

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EDUCATION CITOYENNE AUX NANOTECHNOLOGIES: DEVELOPPEMENT DE LA PENSEE ETHIQUE DES ETUDIANTS

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RESUME

Dans le champ de la didactique des Questions Socialement Vives (QSV), nous expérimentons des dispositifs contribuant à la construction de questions controversés, de capacités d'engagement citoyens et le développement la pensée éthique de l'élève. Les travaux ici présentés ont une visée praxéologique. Le croisement de plusieurs champs théoriques en lien avec les nanotechnologies (la nanoéthique, la sociologie et les sciences politiques, la philosophie politique) et surtout de leur évolution depuis 15 ans permettra de mettre en évidence les lacunes à considérer pour penser cette éducation citoyenne. Les apports de l'éthique du care fourniront les jalons pour bâtir des dispositifs didactiques contribuant au développement de la pensée éthique chez les apprenants ainsi que leur *empowerment*. Ces jalons serviront ensuite de guide pour l'élaboration d'une ingénierie de débat sur une QSV en lien avec la nanomédecine reposant sur des dérangements moraux.

PALAVRAS-CHAVE

Questions socialement vives, Éthique du care, Éducation aux nanotechnologies, Pensée éthique.

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Citizenship Education in Nanotechnologies as a Means of Developing Ethical Thinking Among Students

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NANOTECHNOLOGIES: AN OCEAN OF SOCIALLY ACUTE QUESTIONS

Citizenship education in technosciences necessarily relates to the idea of democracy in Western societies (Dewey, 1916), and to the relationships at work between democracy and education. In this paper, I shall inquire into such relationships, particularly with respect to the development of ethical thinking and empowerment in learners. My focus will be on a specific example of technoscience: nanotechnology and the teaching of social and ethical knowledge (Panissal & Brossais, 2012).

Among others technosciences (Hottois, 2006), nanotechnologies encompass a large array of techniques, applications and issues, making it difficult to attribute a stable definition to them. For now, there seems to be a kind of consensus about one common point: their scale (10-9 m), or that these technologies make it possible to miniaturize objects and materials to less than a hundred nanometers. Nanotechnology's multi-sectored applications can be grouped into three main domains: materials, information technology and health. Nanotechnologies represent more than a technological shift, they also elicit considerable debate with respect to political and economic programs, ethical issues (Leweinstein, 2005) and civic participation (Laurent, 2010). Since they were introduced at the 1999 National Nanotechnology Initiative (NNI) in the United States, they have been developed with a clear itinerary and a precise calendar, including social preparation for nanotechnological applications (Tour, 2007). As a precaution, the Social and Human Sciences were involved in research programs from the inception of such technologies in order to control potential risks (Thoreau, 2012). The consideration of ethical issues over more than fifteen years has led to intense reflection on nanotechnologies and their Ethical, Legal and Social Implications (ELSI). A periodical, Nanoethics, was created in 2007; a code of good practice was published by the European Commission for researchers; lists of potential socioethical consequences, in terms of toxicity, protection of privacy, human improvement and social justice were produced (Thoreau, 2012). The ELSI method has been met with a number of criticisms regarding its heavy reliance cost/benefit analysis, and has been accused of avoiding the real ethical issue of nanotechnologies; namely, their capacity to affect our human condition and hypothetically our moral judgments. Many researchers in ethics therefore attempt to go beyond analysis through co-constructed and contextual intervention (Guchet, 2014). That kind of pragmatism calls into question the ways in which socioethical knowledge as it relates to nanotechnologies is taught in secondary education.

CITIZENSHIP EDUCATION: CONNECTION WITH THE ETHICS OF CARE

Within the framework of NanoEcole, we have been studying the ways in which nanotechnologies are being taught at the middle- and high- school levels since 2007. Pedagogical strategies aimed at providing a citizenship education in nanotechnologies have been developed by multidisciplinary teams of educators at the secondary school level (Panissal, Brossais & Vieu, 2010). Initially, our work focused on the teaching of socioethical controversies in the technosciences, and on the development of ethical thinking through SAQ-propelled debates. Although some might criticize this work based on its reliance on the ELSI method, we believe that the identification of ELSI is still essential for students. Indeed, it seems that the impact of nanotechnologies is lesser known by the public than in the case of other SAQs. Since we began researching these issues, we have systematically questioned students and teachers about their uncertainties related to nanotechnologies, and we have often gotten the same response: "we never imagined that there was so much to it". It therefore seems worthwhile to target the construction of an ELSI type of socioethical knowledge. All the more so since SAQ-propelled debates have proven to be good pedagogical tools that allow students to delve into ethical issues related to nanotechnologies, to think critically about modes of governance (Bensaude-Vincent, 2009; Panissal, 2014; Panissal & Brossais, 2012), and to test out ethical issues in the real world. In that sense, even if debates up to now have been colored by the ELSI method, as discussions, they contribute to empowerment. After these past years of research, we believe it is worthwhile to deepen our understanding of how education can lead to empowerment through the development of ethical thinking.

Lipman (2003) defines three thinking styles: critical thinking, creative thinking and caring thinking. Critical thinking is a way to think with applications, to examine a fact or a principle to establish its relationship with judgement. Critical thinking facilitates judgement because is based on criteria (rules or principles), is self-correcting and sensitive to context. Creative thinking is an increase in a way of thinking, is a way to amplify the thought beyond the present situation. This kind of thinking mobilize abilities like imagination, transfer, originality, creativity, independence and detachment of field to create novel, original thought, to empowered thought. Creative thinking also use reasons, standards, criteria and involves critical thinking. Caring thinking allows the entry of emotions in thoughts. It is a way to be aware of the role of emotions in thinking. It is a way to build a different outlook on a situation, to appreciate the value of an object, idea, person, etc. For Lipman, caring thinking is an appreciative, affective, active, normative and empathetic thinking. Finally, for each of these three styles of thinking, thinking is the centre of a process, a pre-requisite to higher order thinking, and thinking is the subject of education.

We now focus on ethical thinking. For Lipman, thinking caringly "means to think ethically, affectively, normatively, appreciatively and to actively participate in society with a concern for the common good" (2002, p. 271). We use the term of "ethical thinking" in order to consider that thinking is more than accumulating knowledge. It involves the ability to value, choose and judge with the necessity of care and justice but also to insist on two important aspects of ethical thinking: care and normativity (cf. next

paragraph). Ethical thinking is a way to evaluate and value nowadays' technological innovations. Today we can observe in many people a devasting feeling that in the end perhaps nothing really matters, that no one person can really do anything that will make any real difference in creating a better world (Sharp, 2004). In this context, it is important to educate students that they really do matter for a sustainable society. Indeed, a good life is linked with what we care about, what we value, what we think truly important. For Sharp (1997), this is the source of the criteria we use to evaluate ideas, ideals, persons, events, things and their importance in our lives. The logics of technoscientific rationality has followed the path of hypermodernity. The pillars of modernity (the state, science, the market, the individual) have colluded with excess and have colonized the lived world, in the Habermassian sense, in the service of a new authority: economic profitability (Lipovestky, 2004). Left unchecked, hypermodernity has led to an excrescence of all the pillars of modernity (the state, science, the market, the individual), each with an outsize mission to exist at the expense of all the others pillars. But what might be capable of putting them in check? As in any struggle against domination, new tools for thinking must be created (Adorno & Horkheimer, 1974). The advances over the past 15 years of SHS research in nanotechnology (Guchet, 2014) highlight some elements that might prove useful in developing an ethical framework: targeting local contexts and affected communities, taking into account the present (what already exists), making use of the skills of all types of researchers, changing our ethical perspectives, examining moral routines in order to foster a process of questioning vis a vis our conceptions of the good life, considering ethics as a praxis.

Ethical thinking as a praxis cannot occur without collaboration, without inquiry. This collaborative inquiry in the classroom implies authentic dialogue, respect for each other as persons, a mutual trust and the ability to communicate with others. It allows learners to discover the values of others and to consider what other people care about. It promotes an environment in which students can behave emotionally, rationally, socially and politically:

> This involves a consideration of alternatives through examination of the reasons supporting each alternative. Since the deliberation usually takes place in preparation for the making of a judgement, we speak of the process as a weighing of the reasons and the alternatives. (Lipman, 2003, p. 96)

It is an immersion into a democratic aesthetic experiment that guides interpretation of the sense of human action. We think, along with Dewey and Lipman, that one aim of the education system, in a democratic context, is to stimulate reflective and autonomous thought and give rise to dialogue and inquiry in order to fight against ignorance and injustice. "Our society could not be fully civilized and our schools could not be fully satisfactory (…) until students were converted to inquiry and thereby prepared to be participants in a society" (Lipman, 2003, p. 34). Finally, ethical thinking education in nanotechnology can be connected to such inquiry because caring, critical and creative thinking can make a collective discussion possible for the practice of high level thinking. Such an inquiry opens the investigation of the multiple challenges and the associated ethical and social vulnerabilities. As I now discuss, some elements cohere with many of

the preoccupations at work in the field of the Ethics of Care (Fischer & Tronto, 1991; Gilligan, 1986).

Fischer and Tronto (1991) suggest that care be considered a generic activity that includes everything we do to maintain, perpetuate, and repair our world in order to live in it as well as we can. That world consists of our bodies, ourselves, and our environment all the elements we seek to connect in a complex network that sustains life. Their broad definition does not limit itself to human interactions, but also applies to the environment and to objects in our environment. It is also compatible with nanotechnologies, which implicitly contain the idea of a hybridization of the human body with technological elements. Although in moral philosophy Care Ethics is embedded in the events of daily life, several thinkers in the field suggest politicizing care in order to reposition it from its place of private morality into the sphere of political theory (Tronto, 1993). Care is a politics of the ordinary: in the face of ordinary reality, individuals take care of each other, thereby ensuring the continuity of the world (Laugier, 2013). Recast and politicized, care becomes a power distributed amongst all individuals, as well as a new form of organization for thinking, structuring and acting in society. Ethics of care can thus be applied to supplement contemporary moral theories of justice (which consider subjects to be autonomous and rational), whose political practices are grounded in universal rules and general principles that apply to all in the service of social cohesion. The concept of care undermines the idea of universalism through its focus on individuals outside of general frameworks. Its aim is not to make atypical people conform, but to take them into account, to come up with solutions that are not simply universal, but so as not to exclude people also specific. The moral stake here is to go beyond an idea of justice in terms of logic (in terms of rights), and to include a relational logics of responsibility toward one another (our relational co-responsibility). Care Ethics puts into action the conception of social justice through a conceptualization of attentive justice that takes into account specific realities. It sharpens the ways in which we look at behavior and often overlooked facts of life. It helps establish new moral criteria, such as attentiveness, listening, concern for others, and even understanding the vulnerability of the subject (Tronto, 1993). Today's hypermodern world overemphasizes autonomy, which conceals one of humanity's defining characteristics: its vulnerability and its intrinsic dependence on others. Care is not only an abstract moral principle; it is also a practice that encompasses need, attention, concern, commitment, the ability to act in a given context, and creative reflexivity. In her most recent work, Tronto (2013) has developed an idea of democracy and citizenship in relationship to care. Fischer and Tronto (1991), and Tronto (2013), have delineated the various facets of the praxis of care.

Table 1
The Dimensions of Care, the Moral Qualities and Skills Related to Care as Praxis

Stages of Care	Moral Attitudes	Skills
Caring about	Awareness of the needs specific to a given context Awareness of vulnerability	Inter-personal skills ability to understand a need in a given context ignorance perpetuates inequality and injustice (importance of knowledge) recognize the need to respond
Taking care of	Responsibility Concern (beyond obligation)	Inter-personal skills relate to others make oneself available to respond to needs recognize that we can act
Care giving	Competence	Know-how, inter-personal skills act, material work consider the specificity of the situation moral quality: don't give up due to perceived incompetence
Care receiving	Reactivity	Know-how, inter-personal skills on a meta level evaluate requirements/context readjust, learn: constant adaptability (accompaniment) effectiveness of care
Caring-with	Trust and solidarity	Reiteration of the care process, independently of the context Caring behavior

Care can only function if we modify the context in which we think. In order to think differently, we have to create moral and political criteria and new tools of thought. Studies undertaken in the field with professional healers, caregivers, and social workers demonstrate that professional behavior is affected by the encounter with others; it guides the moral stance of professionals (Molinier, 2010). It is for that reason that transposing the theory of Care Ethics into the field of education seems useful to us. Such a transposition encourages us to think about the various steps involved in education and about what elements might allow people to perceive the vulnerability of the world and ask good questions, with respect to present-day life and not a hypothetical future. The task is not easy. Steps have been taken, for instance, in the field of political science, where imagining a benevolent and responsible society entails conceiving of ways to change how the state operates so that it can become supportive and anticipatory (Guérin, 2011).

We have therefore worked to transpose the conceptual framework of care into the development of students' ethical thinking by using nanotechnology-based SAQs. The aim is to help students develop an ethical framework for acting in their lives as future citizens. More specifically, during previous studies in which we analyzed students' rationales with respect to Habermassian objective, social, and subjective worlds (Panissal, 2014), we revealed the importance of subjective and social rational thinking used by students.

These forms of rationality relied on examples from students' personal lives. They allowed students to problematize an ethical issue in order to discern what was important with respect to nanoelectronics and smart objects. For example, in 2013, a class of freshmen [troisième] engaged in a lively conversation on the ways in which we consent to delegating power to connected objects (refrigerators, smartphones), becoming more and more reliant upon objects and losing some of our autonomy and freedom (Panissal, 2014). That example reinforces the idea that, in order to facilitate students' ability to make sense of ethical issues, it is worthwhile to encourage them to think from the present moment and about their own life experiences. However, in another sense, it is also worthwhile to guide young people away from the conformism and egocentrism inherent to the adolescent period in order to encourage them to develop their own ethical thinking. The dialectics of education are therefore complex: use the local (what is close to students) in order to awaken their sense of concern, and slowly guide them into more general topics. To that end, the conception of ethics in three dimensions (Morin, 1999) can serve as a guide for educators in their class preparations. 3D ethics demands that we think ethics in terms of ourselves, our moral responsibilities, and our integrity. It also makes use of a socioethical idea based on shared responsibility. That idea is motivated by a duty to justice that contains a legal responsibility toward political autonomy through democracy, as well as an anthropological ethics that takes all of humanity into account (historically and culturally speaking) and encourages reflection on the responsibility for sustaining the world while promoting a social responsibility toward progress and the autonomy of future generations. 3D ethics is a key ingredient in a complex thought process and acts as a counter-power to neoliberalism; it provides a sharp look into what is really important for people. The three-part idea, which serves as a guide for thinking about issues, is doubly interesting to us. On the one hand, it helps us envision a pedagogical model (through the preparation of a debate) that gets students thinking beyond the local and guides them toward imagining vulnerabilities that are more and more distant from themselves. On the other hand, this decentering from the context encourages students to rethink the limits of their conformist reasoning and helps them develop a post-conventional moral thought process (Kohlberg, 1969). In Table 2, we show the five stages of carethat were previously adopted by Tonto (2013) to reflect on possible elements which would inform an educational model linked to an SAQ-propelled debate.

Table 2
The phases of care as tools for thinking the steps of an SAQ model debate.

Phases of care and moral attitudes	**Steps of the debate and criteria**
Caring about	Debate preparation: attention to vulnerability (self, social, human) - ELSI: students do research to understand the breadth of - ELSI questions (group work) - heuristic mapping with the whole class on ELSI - choice of an issue for debate that relates to everyday life: critical thinking about moral positions.
Taking care of	Debate preparation: concern - encounter with others: laying out different points of view: students research the arguments, needs, and interests of those involved - heuristic mapping of the interested parties
Care giving	The debate: the deliberative process, action deliberative debate, argumentative practices, different rationales, problematization - civic empowerment: various practices of participative democracy in context (people and places)
Care receiving	After the debate: ethical and political empowerment, novel creation - ethical ability: construction of an ethical framework of reflection, ability to think critically and ethically and to engage in a process of inquiry (process of inquiry, Dewey) - civic competence: construct and intervene in civic life, act and transmit one's experience
Caring-with	Ultimate goal: Student autonomy (beyond the context of school) - appropriation of confidence and solidarity - autonomously reproduce the process of care, independently of the context: Evaluate what we care about, value, think truly important - criteria to evaluate ideas, ideals, persons, events, things and their importance in life - moral questioning on how to sustain the world

IDEAS FOR A PEDAGOGICAL MODEL THAT GETS STUDENTS TO THINK ABOUT ETHICAL THINKING: THE EXAMPLE OF NANOTECHNOLOGIES

In our work, we have conceived of ethical thinking as the capacity to consider possible actions in a world filled with uncertainties. Ethical considerations, as Tronto (2013) tells us, must take into account the just and the important; we must sharpen our vision and rely on the right criteria at each step. The aim of our education device is to encourage students to think critically about technoscientific advances and to engage in a process of inquiry (in the service of problematization) according to Dewey's conception (1916). It is

to get them to conduct pragmatic inquiries, identify issues, envision scenarios, examine what works and should be conserved. This goal is intimately linked to the development of an ethical line of thinking that is sensitive to what makes for a fair and caring society and the sustainability of the world. Nowadays democracies must provide an education that addresses the increasing complexity of the world. Facing with globalization, society must ensure the empowerment of pupils and students, must provide an education that allows young people to mobilize their skills and understanding in order to confront the new challenges successfully.

IDEAS FOR MAKING STUDENTS ATTENTIVE TO VULNERABILITY

Document-based research on nanotechnologies and the practice of debate allows students to grasp the breadth of controversies within the field (ELSI); it awakens their thinking and it draws their attention to the vulnerability of humankind. Still, it is important to encourage adolescent students (who are developing their moral compasses) to consider the limits of their egocentric and conformist thinking and to develop a conception of morality that includes concern for others, the respect of social rules, the respect of the fundamental rights of a democratic society, of the right to life and liberty, and the construction of ethical principles that are universal to all of humanity. We believe that the debate preparation phase is fundamental and that it must include 3D care thinking (individual thinking, social thinking, humanity thinking). However, for the sake of efficiency, ethics is increasingly called upon to speak to specific contexts, becoming an ethics of accompaniment rather than an ethics of evaluation. In order to transpose ethical considerations into the field of education, it is important to consider well-anchored moral ideas, or the routines that we take for granted (Dewey, 1916). Such ideas or routines go unnoticed until they no longer work or no longer offer answers or strategies for guiding our behavior in new moral situations. For example, during an analysis within the context of medical care, traditional ethics requires that the doctor maintain patient confidentiality. Yet, if the patient's disorder, because it has an inherited component, implies consequences for his or her (already born) descendants, does the doctor have a responsibility to inform the family or not? And would such a responsibility apply in cases that go against the patient's wishes? Such a situation is complicated and would force the doctor to reconsider the notion of responsibility. Indeed, moral conduct corresponds to the implicit, unproblematic acceptance of routines. Ethics is most evident when there is a conflict. What must one do? Ethics therefore deals in controversy; it demands explanations and inquiry; it brings urgency to an issue of moral dilemma, and it is in this sense since it heats up a context that it is interesting for SAQs. Nanotechnologies undermine our moral judgments and force us to confront the unknown. Technoscientific advances will necessarily destabilize our moral routines. For instance, when DNA sequencing becomes affordable, what consequences will it have for potential forms of discrimination? Will we have to pay surcharges on our health insurance if we have genetic risk factors? Who will own, use and be responsible for the genetic information gathered on individuals? One pedagogical strategy might consist in eliciting a debate that undermines moral beliefs. Or posing ethical questions, based on present-day issues, that consider a future for which our cultural baggage does not have moral answers.

IDEAS FOR CONSTRUCTING RESPONSIBILITY

Analyzing arguments from the various interested parties in a debate is an indispensable tool in the pedagogical process, as it helps students consider and modify moral stances. Such an analysis encourages students to unpack discourse, and to make the sources of conflict visible in a far more nuanced manner than the type of black-and-white thinking promoted by the media. They are also encouraged to examine the economic, social, democratic, ethical and political stakes as they relate to each of the protagonists. The thoughts of the parties involved are thus put into context and historicized, which makes it easier for students to perceive oppositions and to engage in everyday ethical questioning. Encouraging students to take an interest in the needs of parties involved in a conflict, in the context of a pedagogical preparation for debate and with the help of heuristic mapping, seems to be an interesting way to reflect on moral routines, elicit good ethical questions (ethical problematization), and give meaning to values. Such debate preparation is essential, as it makes it possible to discuss and inquire into values with the class. Values are what humans respect, hope to obtain, recommend and consider ideal (Rezsohazy, 2006); they allow humans to adhere to goals, which serve interests that motivate them and that seem important in everyday life (Schwartz & Bilsky, 1987). They serve as a guide, as a yardstick to evaluate, dictate behavior and make choices. At times, values vary depending on context and the ways in which individuals prioritize. Nevertheless, they reflect a certain form of universalism, in the sense that they strive for human dignity and the common good. We are currently researching debate protocols on the previously mentioned issue of DNA tests. So far, the ongoing analyses of the heuristic mapping show that students are more likely to understanding the social and ethical stakes of an issue when they are asked to relate them to the various players involved (doctors, researchers, the social health care system, insurance companies, patients, families, pharmaceutical laboratories, IT professionals, lawyers, etc.) and to consider their underlying values and concerns. We hypothesize that, for students, the act of visualizing the arguments and underlying values of interested parties helps them to better understand the intricacies of the controversies and responsibilities at stake and to move away from the black-and-white thinking. The posture of care acts as a counter force, making way for an ethical relationship with others in a hypermodern world that prizes individualism.

IDEAS FOR COMPETENT ACTION

An SAQ-propelled debate in the context of a pedagogical discussion that has been engineered to build an appreciation of controversial scientific, social and ethical topics is an effective way to build knowledge (Panissal & Brossais, 2012). This type of debate also exercises participative democracy in a school setting. The Habermassian model of communicative action envisions space for deliberation in which each citizen is free to participate in a cooperative, truth-seeking debate that aims at resolving a problem in the lived world. The best argument in such a debate leads to consensus and the acceptance

of common norms and/or the construction of knowledge and the elaboration of an issue (Panissal, 2014).

So conceived, civic participation relies on the effectiveness of the deliberative mechanisms at work in post-industrial democracies. However, today the available deliberative processes do not have the desired effect, and they remain dependent on the intervention of experts to fill in the gaps for which regular citizens are unable to account. They therefore perpetuate disciplinary divisions and make it impossible to properly conceive of uncertainty in complex situations. This phenomenon is all the more complex in the ambiguous context of the debates surrounding nanotechnologies, in which participative solutions engineered by research and development policies provide the appearance of an openness to civic society for responsible and acceptable innovation (Laurent, 2010). Empowerment, of course, relies upon a citizen's ability to deliberate in a debate. SAQ-propelled debates on nanotechnologies at the middle- and high-school levels foster such a capacity. But civic empowerment goes beyond that; in order to make such skills emerge, it relies on the intermediary of the collective. The group and the individual are therefore agents in their own transformations (self-transformation) as well as in the transformation of their environment. That kind of governance demands a radical transformation of the agents (Maesschalck, 2008), forcing them to think beyond their local interests and imagine a universalism; it necessitates spaces for deliberation that encourage different points of view, the diversity of which work for the common interest and the construction of a patrimonial democracy. Civic empowerment leads to the creation of multiple, critical civic groups capable of focusing on different aspects of nanotechnologies: the creation of norms, questioning scientific policy and even the organization of a democratic society's participative procedures. In sum, it fosters the existence of multiple groups with different preoccupations, and it is on this plurality that the lived world relies in order to give way to the emergence of criticism and action, to make democracy come alive and not as a frozen state, but as a dynamic process under construction.

IDEAS CAPABLE OF ELICITING REACTIVITY

This phase is essentially developed after the debate and takes on different forms: presentation to the class of knowledge that has been learned, heuristic mapping related to the adopted SAQs, end-of-year sketches for parents, role playing on ethical committees, posters, class newspaper, and fictional narratives. The various methods we tried were conceived to problematize ELSI forms of knowledge or to analyse the participation and argumentation of the participants of a debate in such a way as to meet the education system's requirements at the middle- and high-school levels. The activities also encouraged students to explore the various elements that make up a participative democracy: citizens' juries, whistle blowers, ethical committees, consumer groups, vulgarization of information. Meeting with people outside of school also allowed students to grasp the reality of their discussions.

Teaching science such as it is conceived in the SAQ model is not limited to teaching scientific concepts (including controversial ones); rather, it extends to topics ranging from the nature of science to the development of active democratic civic capacities

(Simonneaux & Simonneaux, 2012). Pedagogical scenarios can therefore be used to lead teachers toward activism and to engage in social and political actions related to a given context in the classroom (Bencze & Sperling, 2012). Although they are still in laboratories, nanotechnologies already offer a number of avenues for examining the evolution of both new and existing values. In nanomedicine, for example, nanotechnologies have optimized DNA sequencing, reducing the cost and making it more accessible; as a result, health tests can be rendered massively availabble (see the 2014 Senate Report on nanomedicine). Dewey's method of inquiry allows us to imagine possibilities, not as a direct link between pre-established means and ends which is to say, a genotyped patient digitized in big data whose health is managed by algorithms made from profitable genomic profiles but as an attentiveness to the pragmatic context's vulnerabilities for the sake of creating a sustainable world. To borrow from Hodson (2010), students must also be able to live participation in order to be invited to negotiate tomorrow's values. Thus, in order to encourage the development of moral judgment in students, educators should consider the mechanisms of ethical empowerment. A potential source of inspiration could be the groups and networks of civic empowerment that have been active in the world for the past twenty years. Those networks have been becoming increasingly institutionalized, across various sectors such as, for example, at the level of city politics, social economies, the environment, and health. Using local experience as a starting point, they have produced guides, feedback surveys, action plans, reports empowering citizens to act, and an array of materials designed to give individuals the tools to empower themselves and enact change. As Guchet (2014) has suggested for ethics committees, in the scholastic context, the aim would be to bring students into the laboratory, to the very place where nano-objects are still being developed, and have them dialogue with teams of researchers on the role of nanotechnologies in society. The following example may prove enlightening. During a freshman class debate [classe de troisième] on the potential toxicity of titanium dioxide found in sunscreen, one student wondered about the interaction between that nano product and the one in her watch that made it change color. "If I'm playing volleyball on the beach and I get hurt, what happens with the nano products in the sunscreen and the ones in my watch?" This example shows how even a high schooler's perspective can lead to new research. If we want students to be able to create a new world, educating their minds and methods of thinking is essential.

CONCLUSION

Schools are particularly affected by today's technological and scientific advances, and more generally by globalization. There is a need to inquire into the type of scientific and civic culture to transmit to the twenty-first century. The task is all the more urgent since "today's neoliberal ideology has become hegemonic and seeks to impose onto school systems the values and social norms that suit the economic needs" of the market, replacing Keynesian state intervention (Lenoir, 2012, p. 12). The issue seems even more pressing since there are plans to institute nanotechnology programs across the world for young learners (Greenberg, 2009). It is worth wondering about the relationship between such programs and the thorny question of social acceptance with respect to

nanotechnologies, and we might wonder whether "the functions of the educational system (…) have shifted from transmitting cultural tradition and knowledge (…) to acculturating students to a market economy in which all humans must submit to its demands, its limitations, its entrepreneurial ethics" (Lenoir, p. 16). It is essential that the school system as a pillar of democracy (Dewey, 1916) imagines education not as a process of adapting students to society's current needs, but as a means of raising students for the future and building the foundation of a future harmonious society. The school system must help develop critical thought and judgment so that students can participate in the public sphere. The school system also has the difficult burden of taking on changes in a democratic society, contributing to democratic innovation and helping to sustain the world (Ballet, Dubois & Mahieu, 2005).

In terms of social pragmatism, Dewey (1916) provides a rich reflection on democracy and education. That theoretical framework seems particularly apt for considering nanotechnological issues and could serve as a reference for developing curricula on the ethics of nanotechnologies in the field of SAQs. In political philosophy, Maesschalck (2008) explicitly references pragmatist theories of education related to democracy, in order to foster participative capacities among interested parties so that they are capable of enacting democratic innovation. Nevertheless, the capacities cited by Maesshalck would be difficult to apply to the school system such as it is today. Indeed, their aim is civic empowerment. Beyond that, they seek to create a memory of moments of action that must be implemented and constructed over time and as a function of the results of the various groups of empowered agents. The transposition of Tronto's work (2013) into the field of education practice makes for a critical pedagogy situated at the crossroads of power, educational practices, and values, and its goal is to change society. It values practices that inquire into how to live a better life and leads teachers onto and difficult territory that of going beyond their role as disciplinary experts. In such a context, teachers would have to rely on different sources of authority and epistemic communities. They have to adopt a particular view of personhood and pedagogical education in order to create an environment of the cultivation of such thought.

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SUBJECT IN SOCIALLY ACUTE QUESTIONS CLINICAL DIDACTICS: A NEW APPROACH TO STUDY TEACHERS SUBJECTIVITY

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ABSTRACT

In socially acute question didactics and "education for" subject-specific areas, the objects of teaching are not considered to be fixed and they entail values and controversial issues. The set of issues related to neutrality thus arises for these problems, which combine advanced and often fragmented scientific knowledge, ethical issues, and complex political and administrative issues.

The question of teacher opinion is particularly important in teaching these uncertain kinds of knowledge (Girault & Lhoste, 2010). The teaching of socio-scientific issues (SCI) confronts teachers with taking a new position: that of committed impartiality, whereas instructional communication has traditionally been built on a duty to remain impartial and neutral regarding schoolroom discourse (Urgelli, 2009). The particular context in which content knowledge is not stabilized raises once again the question of teacher subjectivity.

This paper proposes reflecting epistemologically on the different ways of studying teacher subjectivity in their teaching of, or providing instruction on, socially controversial issues. Research on SCI teaching practices focuses on actors or subjects according to their theoretical and epistemological grounding, for example social representations (Jeziorski & Legardez, 2013), fostering socio-political activism (Bencze, 2013), positions taken by educators in handling controversial issues (Kelly, 1986), the heating up and cooling down of socially controversial issues (Legardez & Simonneaux, 2011), neutrality and commitment (Simonneaux & Legardez, 2008), and relationship to uncertainty and challenges (Brossais, 2014). The aim of this article is to present an outlook of the research relative to teachers' subjectivity on didactics of socially acute questions, and then to propose an original perspective such as teachers practices clinical analysis coming from clinical didactics French field of research.

This paper situates the context in which my broader study on clinical didactics of socially acute questions takes place.

KEY WORDS

Neutrality, Teacher positioning, Subject, Clinical didactics, Socially Acute Questions.

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A TEMÁTICA DAS QUESTÕES SOCIALMENTE VIVAS EM CLÍNICA DIDÁTICA: UMA NOVA ABORDAGEM PARA ESTUDAR A SUBJETIVIDADE DOS PROFESSORES

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RESUMO

Na didática das questões socialmente vivas e da "educação para" disciplinas de áreas específicas, os objetos do ensino não são considerados fixos e implicam valores e questões controversas. Um conjunto de questões relacionadas com a neutralidade surge, assim, para estes problemas que combinam conhecimentos científicos avançados e muitas vezes fragmentados, questões éticas e complexas questões políticas e administrativas.

A questão da opinião do professor é particularmente importante no ensino destes tipos incertos de conhecimento (Girault & Lhoste, 2010). O ensino de questões sociocientíficas (QSC) confronta os professores com uma nova posição: o do compromisso da imparcialidade uma vez que a comunicação da instrução foi tradicionalmente construída sobre o dever de permanecer imparcial e neutro em relação ao discurso escolar (Urgelli, 2009). O contexto particular no qual o conteúdo do conhecimento não é fixo levanta, mais uma vez, a questão da subjetividade do professor.

Neste artigo propõe-se refletir epistemologicamente sobre as diferentes formas de estudar a subjetividade dos professores no ensino de, ou ministrar instrução sobre, questões socialmente controversas. A investigação sobre as práticas de ensino de QSC foca-se nos atores ou sujeitos, de acordo com os seus fundamentos científicos e epistemológicos, como por exemplo, as suas representações sociais (Jeziorski & Legardez, 2013), promovendo o ativismo sociopolítico (Bencze, 2013), posições adotadas pelos educadores no tratamento de questões controversas (Kelly, 1986), no acalorar e no arrefecer destas questões controversas (Legardez & Simonneaux, 2011), neutralidade e compromisso, e na relação com a incerteza e com os desafios (Brossais, 2014). O objetivo deste artigo é apresentar uma perspetiva da investigação relativa à subjetividade dos professores sobre a didática das questões socialmente vivas propondo uma visão original tal como a das práticas dos professores sobre análise clínica, vinda do campo de investigação da didática clínica francesa.

Este artigo situa-se no contexto do meu estudo, mais vasto, sobre a didática clínica das questões socialmente vivas.

PALAVRAS-CHAVE

Neutralidade, Posicionamento do professor, Matéria, Didática clínica, Questões Socialmente Vivas.

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LE SUJET EN DIDACTIQUE CLINIQUE DES QUESTIONS SOCIALEMENT VIVES: UNE NOUVELLE FAÇON D'ETUDIER LA SUBJECTIVITE DES ENSEIGNANTS

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RESUME

En didactique des Questions Socialement Vives et dans le champ des éducations à, on considère que les objets de savoirs sont non stabilisés, porteurs de controverses et des valeurs. La problématique de la neutralité est réactivée pour ces problèmes qui mêlent des savoirs scientifiques poussés et souvent éclatés, des enjeux éthiques et des enjeux politico-administratifs complexes.

La question de l'opinion de l'enseignant se pose particulièrement dans le cas de l'enseignement de ces savoirs incertains (Girault, Lhoste, 2010). L'enseignement de controverses socio-scientifiques confronte les enseignants à un nouveau positionnement : celui de l'impartialité engagée de l'enseignant alors même que la communication didactique est construite traditionnellement sur un devoir d'impartialité et de neutralité des discours scolaires (Urgelli, 2009). Ce contexte particulier où les savoirs ne sont pas stabilisés ravive la question de la subjectivité des enseignants.

Cette communication propose une réflexion épistémologique sur différentes manières d'étudier la subjectivité des enseignants en didactique des QSV. Représentations sociales (Jeziorski et Legardez, 2013), promotion d'un activisme socio-politique (Bencze, 2013), posture dans les débats (Kelly (1986), réchauffement et refroidissement des QSV (Legardez et Simonneaux, 2011), neutralité et engagement (Simonneaux et Legardez, 2008), rapport à l'épreuve (Brossais, 2014). L'objectif de cet article est de présenter un panorama d'études existant sur la subjectivité des enseignants en didactique des Questions Socialement Vives puis de proposer une posture originale d'analyse des pratiques enseignantes venant du champ de la didactique Clinique développée en France.

MOTS-CLES

Neutralité, Positionnement des enseignants , Sujet , Didactique clinique , Questions Socialement Vives.

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Subject in Socially Acute Questions Clinical Didactics: a New Approach to Study Teachers Subjectivity[1]

Emmanuelle Brossais

As with the French didactics of disciplines research, in teaching socially acute questions there is interest in the characteristics of the content knowledge transmitted. The swift evolution of technological and scientific content knowledge has led to problems in teaching that mix very advanced and often fragmented types of scientific knowledge, ethical issues and complex political-government problems (such as those associated with GMOs, stem cells, avian flu, nuclear waste, biodiversity et alia). In common with socio-scientific issues (SSIs), socially acute questions (SAQs) have the potential to raise open-ended questions that involve complex problems that integrate knowledge from the humanities and the sciences.

Socially Acute Questions are assuredly complex and the bearers of uncertainty; handling them instructionally assumes taking into consideration social implications, ideologies and values. These transformations have led researchers to reflect upon pertinent approaches to teaching, given what is at issue in transmitting knowledge. In the report entitled Teaching Controversial Issues: A European Perspective from the Children's Identity & Citizenship in Europe Thematic Network (Berg, Graeffe & Holden, 2003), a controversial issue is defined as having five characteristics[2]: there are competing values and interests; political sensitivity; strongly aroused emotions; the subject/area is complex; and the subject/area is of topical interest.

Whereas “education for” types of subject-specific areas are developing in French teaching, Laurence Simonneaux and Alain Legardez are interested in the double risk teachers run in dealing with these subjects/areas: “They may give rise to conflicts in the classroom; teachers are no longer those who ‘know’ and now have to question their own positions (neutral versus engaged)” (Simonneaux & Legardez, 2008). Although taking the subjectivity of teachers into account touches on their position, responsibility, and engagement, most studies in socially acute question didactics in France do not deal with the singular nature of individuals or social actors and prefer to consider teachers as members of a group, such as, for example, belonging to a particular discipline for teachers or belonging to a classroom group for students.

In my opinion, it is no longer possible in this research to refer solely to the epistemic subject, the central reference in studies on the didactics of disciplines. The question then becomes: what subject and/or actor is relevant in the didactics of socially acute questions? This paper has three parts. The first is devoted to the transformations

1 The field of SAQs is the French approach to teaching Socio-Scientific Issues.

of the teaching profession and the series of problems they raised about neutrality on these issues that mix very advanced scientific knowledge with societal, political and moral issues. The second part focuses on an outlook of the research relative to teachers' subjectivity on didactics of socially acute questions including an original perspective by promoting teachers practices clinical analysis coming from clinical didactics French field of research, while the third part deals with the methodological corollaries to these conceptions.

TRANSFORMATIONS IN TEACHERS' MISSIONS

The document of reference on skills for teachers and education in France (2013) asserts that all teaching staff contributes to common goals and may, therefore, refer to the profession's common culture, whose identity is constituted by recognition of all its members. On the basis of acting as a responsible educator according to ethical principles (BO, 2013), each teacher and principal education advisor, in particular, is expected to "make a contribution to cross-disciplinary education in subject-specific areas, in particular: health education, civics education, sustainable development education, and artistic and cultural education." This subject-specific "education for" is bringing on changes in instructional practices.

The question of teachers' opinions is raised particularly in the case of teaching uncertain subject-matter knowledge (Girault & Lhoste, 2010). The exchanges between trainee teachers in different subject-matter areas (from two different training institutions (IUFM and ENFA for agricultural education)) show the tension between subject-matter knowledge and opinions (Brossais, Panissal, Simonneaux, Simonneaux, Jourdan Huez & Vieu, 2016). We have proposed a reflection on socially acute technosciences to training teachers from two formation institutes. Three focus groups based on innovating didactical strategies were conducted with sciences teachers, humanities teachers and a mixed group. Must a teacher refrain from giving an opinion in order to be remain objective? May a teacher be suspected of taking a position in defense of a cause or engaging in politics? This is the asymmetrical position of a teacher who "teaches…delivers… [and] transmits something" that is questioned when the student becomes the teacher's equal and a full-fledged citizen in the same society. The neutrality principle of the teacher in the French "republican and secular" school was called for, whether this neutrality was "total" or "religious":

François, (History/geography teacher, from IUFM):

> I'd add here that cloning is a very particular case, since after all we're teachers in a republican secular school, and a great deal of the objections to cloning are to one degree or another dictated by religious thinking, so that's all the more reason for us not to have to deal with it, as it would touch on [certain] issues...

Alain (physics-chemistry teacher) - IUFM: “If we bring in outside speakers, there must be several opinions, there must absolutely be several opinions so we don’t steer the debate… we have to remain totally neutral.”

This is one of the six principles framing the teaching profession in France.[3] Thus, the vie-publique.fr site, published by the Office for Legal and Administrative Information (Direction de l’information légale et administrative[4]), states that according to the obligation to be neutral, the “public servant must carry out duties vis-à-vis all administered parties under the same conditions, regardless of their political or religious opinions, background, or sex, and must refrain from expressing his or her own opinions.”[5]

This point here is about teachers not using their position as a propaganda instrument. Neutrality and secularity go together: French teachers are expected to show neutrality in business, political and religious matters.

But the specificity of socially acute questions is in the fact that they are loaded with uncertainties and that, in that respect, one cannot speak of truth since they put into play divergent values and interests. They invite, as Astolfi says, giving up “the myth of social neutrality in the sciences, restoring the plurality of points of view as regards content knowledge and fostering debate on the issues at stake” (Astolfi, 2005, p. 71).

At present, the site of the National Ministry of Education, Higher Education and Research[6] states that “philosophical and political neutrality is a must for teachers and students” while the term “neutrality” is gone from the document of reference on skills for teachers in France of July 25, 2013 and secularity has been substituted for it (BOEN, 2013). Now, as researchers in education science have pointed out, the school as an institution “at times assigns itself the mission of acting on the issue of values” (Alpe & Barthes, 2013, p. 42) by creating “education for” programs (such as education in sustainable development, civics, and health, to name a few).

The Official Gazette on National Education (Bulletin Officiel de l’Éducation Nationale) defines education on sustainable development (ESD) in these terms: It “should provide training on a scientific and prospective approach to citizens so they may make choices and commitments based on lucid, enlightened thinking. It should also lead to thinking about values, becoming aware of individual and collective responsibilities and the necessary solidarity between intra- and inter-generational territories” (BOEN, 2007). The social challenge, according to Vergnolle-Mainar (2009), is to provide an education that fosters citizenship, throughout the school curriculum, the development of responsible behaviors at school, and daily life through the acquisition of types of knowledge, and the interiorizing of the abilities and attitudes that are legitimated by values (BOEN, 2006).

Albe (2012) showed the reticence among science teachers to integrating socio-scientific controversies into the school curriculum. She observes that teachers “make a dichotomy between neutral, objective scientific bodies of knowledge (content

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[3] Alongside obedience, reserve, morality, professional discretion and reporting (of crimes to the authorities).

[4] This department comes under the State’s actions to develop an information society. The Office for Legal and Administrative Information, within its general mission of providing information and documentation on political, economic, social and international current events, sets itself the task of making Internet access available to users for resources and useful data for understanding the major subjects of interest to the public in controversial issues.

[5] http://www.vie-publique.fr/decouverte-institutions/institutions/administration/acteurs/quels-sont-devoirs-fonctionnaires.html

[6] http://www.education.gouv.fr/cid162/les-grands-principes.html Updated in October 2013.

knowledge) seen as truths on one side, and, on the other, opinions playing out on debatable issues in society" (Albe, 2012, p. 9). Before Albe, Laurence Simonneaux found, in a paper on role playing in biotechnologies that "neutrality is illusory. Points of view creep into utterances" (2001, p. 155). There could be no better evocation of the positivist ideal that assumes that realities have an existence of their own outside of the characteristics attributed to them by an observer, that they are governed by universal determinist laws and the deductive hypothetical approach can know the truth of every reality. The idea of interference, of invasion denoting the term "to insinuate itself into" refers clearly to teachers' opinions, value and attitudes that cannot fail to show up in their speech. By token of the same reasoning, the data gathered by Urgelli in his Ph.D. thesis show the importance of teachers' opinions in their decision-making: the refusal to engage in dealing with controversial issues in the name of apolitical teaching of subject matter, the fear of providing opinions, and the transmission of consensual knowledge as defined in the national program on subject matter (Urgelli, Simonneaux & Le Marec, 2011). Here, I see, as Floro states so well on introducing education on sustainable development into the school system, the "part of themselves they commit to the practices they implement to adapt themselves to transformations" (Floro, 2011, p. 164).

Confronted with teaching content knowledge that is not fixed, teachers are ultimately caught in a three-way cross-fire: their statutory obligation to maintain neutrality, the injunctions in educational policies to provide education in sustainable development, and a positivist model that is very present in the French school system. These questions take place in an international context focusing on teachers' neutrality-position in "education for", particularly on education for environment or sustainable development (Scott & Gouch, 2004; Stevenson, 2007).

TEACHER: SUBJECT OR ACTOR?

In this section, I describe the methods of studying teacher subjectivity in the field of Socially Acute Question didactics.

THE POSITIONS TEACHERS TAKE IN DEBATES

This issue of teachers' involvement was studied by Kelly (1986) who lays out the range of possible positions an educator can take in moderating debates. Not dealing with controversial topics comes under the heading of exclusive neutrality. When a teacher leads students to adopting a single point of view (his/her own), that is exclusive partiality. Neutral impartiality means the teacher does not reveal his/her point of view in order not to influence student debates, while committed impartiality is giving an opinion while encouraging students to confront points of view different than their own. For Kelly, the teacher's position is a rational choice and brings into play his/her

representations. This epistemological option leads to identifying what determines the positions and behaviors of the actors, that is to say, the psycho-sociological factors.

The variety of positioning may be linked to teaching customs and traditions in a particular teaching field. Thus, Laurence Simonneaux (2003) finds that a number of teachers, particularly science teachers, do not feel qualified to direct role playing or debates as they view these activities as coming under a social science heading.

RESEARCH ON THE PSYCHO-SOCIOLOGICAL FACTORS OF ACTORS

Laurence Simonneaux and Alain Legardez discuss the subject of different actors, in particular, teachers, and their "social representations, their value systems, their social and professional identities, their perceptions of internal standards (standards imposed on them), the positions they think they should take … [and] their confidence in their ability to control potentially conflictual teaching situations" (Legardez & Simonneaux, 2011, p. 26).

The psycho-social dimensions of the teaching-learning process were also studied through the commitment of its actors (Simonneaux, Tutiaux-Guillon & Legardez, 2012). Simonneaux and Legardez proposed the opposite ends of a sensorial spectrum of hot and cold to qualify the commitment of teachers as heating up or cooling down socially Acute Questions "as a function of their epistemological doubt, [or] their ecological or ethical convictions" (Simonneaux & Legardez, 2011, p. 26). This image has now been widely adopted by didactics researchers of Socially Acute Questions.

It is useful here to point out that Legardez worked first in teaching economic and social issues, and socially acute issues, in line with the analyses of the relationships to content knowledge with reference to Charlot, Bautier, Rochex and Terrisse. He considers three systems of relationships to the knowledge in play in the processes of production of content knowledge: the scholarly epistemology of content knowledge of reference, the epistemology of students, and the epistemology of the teacher of those students. Insofar as it is close to my own questioning, let us pause at this epistemology of a teacher as defined by Legardez as a "construction coming in part from personal history that may be notably different from institutional epistemology and that of the noosphere, often strongly marked by subject-matter acculturation, a component of internal didactic transposition" (Legardez, 2004, p. 23). Agnieszka Jeziorski and Alain Legardez (2013) make use of comparative reasoning to study the social representations of sustainable development and educating of future teachers in sustainable development according to their own subject-matter grounding. The goal is to sort out the features characteristic of the different populations themselves (in this case, life science teachers and geography/history teachers). The term 'subject' is specifically used here by the authors in reference to social psychology and the theorization of Moscovici (1984) and Abric (2003) on social representations.

RESEARCH ON THE POLITICAL ACTIVISM OF TEACHERS AND RESEARCHERS

Researchers working in the field of sustainable development education also focus on what teachers say about their teaching practices. They make use of narrative accounts to study teacher engagement (France, 2010; Levinson & Amos, 2013). Thus, Lyn Carter studies them by paying attention to partial, selective, contextual and even contradictory elements (Carter, 2013). She is also interested in teacher engagement. I could share her approach to research and the requirement of "intense and active listeners,"[7] but our interests diverge with regard to several points. The methodological background she uses is the sociology of education. Carter chooses to study what is said by an exemplary individual who is presented as the standard for a broader sample. She then seeks to identify whether the description by beginning teachers of their own motivations match the postulates uttered by the exemplary individual. Carter selected a person of reference who is a plant pathologist working with South African farmers and is passionate about sustainable development. She changed careers to become an educator and active advocate of science education and education in sustainable development. In the end, what is very strikingly different from my views is the activist aims of a researcher promoting sustainability, and whose goal is to describe teachers as a potential major obstacle to implementing education for high quality development due to insufficient initial and continuing education. Carter presents what she views as the existing antagonism between sustainability and the dominant neoliberal economy, and in describing a pro-environment commitment allows her own positions in favor of sustainable development to appear. Also, fostering socio-political activism is found in the work of Lawrence Bencze (2013) who discusses the teaching of controversial content knowledge from an anti-hegemonic perspective and against an economic orientation where the final purpose is to generate profits. In this regard, the title of his paper and the acronym of the model he is developing are explicit: "Science Teaching Against the Grain for the Social Good: The Story of an Educational Entrepreneur;" the STEPWISE model (Sciences and Technologies Education Promoting Wellbeing for Individuals, Societies and Environments).

A SUBJECT WHO ACTS

The compliance without pressure[8] given by psychosociologists, the commitment from a Habermasian point of view including activism where a militant action is undertaken in schools to convince students and modify their representations, or the intentionality of

[7] This approach requires collaborators (researchers and participants) to be willing to talk about the obvious, to be intense and active listeners, as well as time to be reflective – to drill down into what is important (Carter, 2013).

[8] This concept aims to describe the consequence of a process of persuasion which result is to give the impression to the individuals concerned that they are the authors of certain decisions. In this manner, a person could thus modify her behavior, her objectives and her choices believing to be responsible of these modifications. http://summitevergreen.com/wp-content/uploads/2015/06/compliance_without_pressure_the_foot_in_the_door_technique.pdf

the subject to transform itself and transform the environment: these are the three modes of thinking that Jean-Marc Lange sets forth (Lange, 2015). His preference goes to Hans Joas' proposal,[9] in that he bases himself on a conception of the subject who acts, or an acting subject, who emphasizes the idea of creativity or "open mindedness to new ways of acting" (Joas, 1992, p. 142, cited in Lange, 2015).

THE PERSONAL SIDE OF THE SUBJUGATED, SINGULAR AND DIVIDED SUBJECT

My research project also focuses on the personal side of the teacher. I recognize questioning similar to my own when Michel Floro (2011) finds that the injunction to teach controversial content knowledge goes beyond the purview of the teaching profession and engages their own lives. Methodologically, I share his interest in evocative questions as they allow for gathering points of view, positions, and attitudes from the discourse of the actors. But I set myself off from his views due to his choice of an experimental perspective (in his study he examines eighty subjects) and the study's comparative approach. His goal is indeed to understand the impact of territory on teachers' conceptions. His results show that although values are associated with sustainable development, there is a distinction between regions: "the protection of nature for Marseille, and, the issue of energy and pollution in the Val d'Aoste" (Floro, 2011, p. 175). The actual formulation of the sentence shows the fading away of the subjects to the benefit of an outside – environmental or imaginary – determinant: territory. In others terms, this approach can appear close to mine on the methodological level but it is different relatively to his epistemological underlying.

In 2016, I had proposed as an interpretative hypothesis a "symbolic position to be assumed, the position of the subject supposed to know (Chevallard, 1985; Lacan, 1966; Terrisse, 1994), representing content knowledge in the classroom as institution" (Brossais, Panissal, Simonneaux, Simonneaux, Jourdan, Huez & Vieu, 2016). In the article already cited, among potential obstacles to implementing the teaching of socially controversial issues that beginner teachers brought up, we identified the issue of the place teachers occupy in terms of content knowledge to be transmitted and their students. If the results presented above are relative to the claim of a total neutrality, the analysis showed more of a moderated vision of teachers who accept the debate on condition that they are not the presenter.

Some teachers accepted the presence of controversial issues in the classroom and the idea of a debate as the teaching method for dealing with them, as long as they were not the ones moderating the debate. They thus showed they want to remain the ones who know this content knowledge they are transmitting. Indeed, in place of moderator, the teacher is no longer the only one who knows; the students know as much as their teachers about these questions and sometimes they know more.

[9] Hans Joas understands action by drawing on the thinking of historical American pragmatism.

The didactic conversion in the framework of clinical didactics, worked into the didactics of disciplines and the didactics of socially acute questions, is substituted for internal didactic transposition. I use the term "didactic conversion" in reference to "somatic conversion" from Freudian psychoanalysis, which describes the conversion of psychic elements into somatic symptoms. By analogy, in clinical didactics, certain configurations of the content knowledge taught bear witness to a psychic construction of the teaching subject elaborated in the course of the subject's history. Didactic conversion enables the study of the conversion of content from the subject's experience into teaching (instructional) content elaborated and transmitted by the teaching subject. This piece of the teaching subject may refer back to experiences in sports or associations as well as those relating to school or family. Didactic conversion thus transforms the question of reference to school-related knowledge contents by identifying that piece of the teaching subject that creates them, actually transmitting them (Carnus & Terrisse, 2013). By doing so, a change of epistemological position occurs: the subject taken into account is not a social actor as defined by social psychology but a subject of the unconscious.

Thus, the subject is subjugated, singular and divided. In the common meaning, subjugated is relative to the idea of obligation and constraint. I mobilized it in its double meaning in French: at the same time to be subjected and to be supported by multiple institutions (class, establishment, education system, company). In psychoanalysis, the subject is the subject of the signifier: "the subject is what represents a subject for another signifier" (Lacan, 1960, p. 299). To say this as Marie-Jean Sauret and Christiane Alberti do, "in its language – for each speech act – the subject is represented" (Sauret & Alberti, 1993, p. 171). That the subject is dominated by the symbolic order and even that this order constitutes the subject refers back inevitably to the question of its division. This is the divided subject ($), divided due to the fact of language. Lacanian theory relates to lack, as Lacanian researchers in clinical psychology point out: "by definition, the subject finds no object good enough that would restore the completeness that is shattered when it comes into the world. It does not find an adequate object because the lost object causes its desire whereas the object that is found is only a substitute" (Sauret, Alberti, Lapeyre & Révillion, 2010, pp. 124-125). Moreover, "Desire is a relation of being to lack. The lack is the lack of being properly speaking. It isn't the lack of this or that, but lack of being whereby the being exists."[10]

For teachers, mastering knowledge and learning ends up being, in this sense, an attempt to maintain the illusion of completeness or wholeness of the subject. By filling in the structural lack (fault), which remains after the human being is "inscribed" into language with the content knowledge of disciplines, in particular in the scientific community, the teacher comes to occupy the place of the knowing subject—as if a pile of knowledge could be an answer to the enigma of the subject. Where knowledge is lacking, the truth of one's being may not be reduced to a name, job or studies (Sauret, Albert, Lapeyre & Révillion, 2010).

[10] Lacan, Jacques. *The Seminar. Book II. The Ego in Freud's Theory and in the Technique of Psychoanalysis, 1954-55*. Trans. Sylvana Tomaselli. New York: Nortion; Cambridge: Cambridge University Press, 1988. p. 223.

The particular nature of my orientation in clinical didactics of Socially Acute Questions comes from taking into consideration personal and unconscious determinants to understand classroom situations, thereby opening them up to new interpretations.

METHODOLOGICAL CONSEQUENCES RELATED TO THE CONCEPTION OF SUBJECT OR ACTOR: A CASE STUDY

As part of her research into the field of adult and lifelong education, Sharan Merriam (2002) defines a case study as particularistic in the sense that it allows one to study a situation, an event, a program or specific phenomenon. In her qualitative approach to interpretation, the author seeks to understand how individuals construct their experience and interact with the social world and the meaning it has for them. In this situation, the method and object of research enter into synergy. Indeed, being interested in the meaning a situation has for individuals, calls for a proceeding by case study.

There are various ways to think of a case study as coherent to the intentions of research and to the underlying epistemological positioning of the authors. However, it is not always possible to identify the subjacent epistemologies in various works. Sometimes the conception of the actor is explicit or can be induced, other times this conception is unknown, and it is rather the degree of interventionism that is specified.

MULTIPLE CASE STUDY

In socially acute question didactics, the term “case study” is used to mean the study of multiple cases for Benoit Urgelli, Laurence Simonneaux and Joëlle Le Marec (2011). Their case study on teaching controversial climate issues includes a media context, French policy decisions and their effect on school curricula, the kinds of engagement possible for some secondary school teachers, and collective approaches to controversial issues. Results from the eight teachers participating in their survey showed that subject-matter disciplines play a role in the way controversial climate issues are approached. The reasoning behind the commitment of each teacher is qualified by matching it to the categories conceived of by Kelly (1986): exclusive neutrality, exclusive partiality, neutral impartiality, and committed impartiality. The goal of the research is thus to bring out the constants and differences comparatively.

SINGLE CASE STUDY

Taking into account what is an irreducible singularity assumes that a study will take into account the personal influences on the act of teaching. That is why studies are studies of an individual case, i.e., done "on a case-by-case basis, one by one" (Terrisse, 1999). This "one by one" factor comes under the methodological conditions that Sauret proposes for focusing on "what is different from one subject to another, but also, what escapes the subject itself: the most precious indicator of the real, of *jouissance* and the conditions of an act" (Sauret, 1997, p. 168).

In their study on socio-scientific issues, Bev France and Jackie Bay (2011) also present a case study of a single vignette. Ann's vignette is given as an example that summarizes the way seven teachers who took part in action research conceived pedagogical strategies to respond to students' needs and allowed them to study socio-scientific issues from various angles. The vignette illustrates, through long verbatim excerpts, the realization that invisible barriers exist in expressing an opinion on a socially controversial issue (barriers of language, a cultural barrier in terms of silent consent,[11] a barrier of access to computers) and the manner that Ann adapted her teaching strategies to help students overcome these problems.

EXCERPT FROM A CASE STUDY ON CLINICAL DIDACTICS OF SOCIALLY ACUTE QUESTIONS: A CLINICAL DIDACTICS VIGNETTE

For my part, I do not consider the teachers on which I build case studies to be representative examples of a community of teachers. I seek to understand the meaning—and have recently added to this the 'outside of sense' (what lies outside meaning)—along with the concept of relationship to uncertainty, or senselessness, as understood in psychoanalysis.

The relationship to an experience explains the sense (meaning) that teachers attribute to what they experience in the classroom, in this space-time of meeting with students where the major challenge is that transmission of knowledge occur. Elements known and unbeknownst to them (of which they are unaware) were expressed at those times when the teacher and this researcher met, whether while observing classroom practices or during one or more interviews with the teacher. A sense of the uncertainty of teaching and the choices made by the teacher bring out known and unknown elements, whereas the playing out of desire of transmission and its drive-related movements are unknown. They reveal a sense or meaning identifiable by the subject or what is outside meaning, which refer to the unconscious of the subject, a lack, and the impossible for each of us and which always escapes us. This is the reasoning I use in exploring a one-by-one or case-by-case subject, that is to say, a singular positioning, and the expression of processes of the psyche in a social, historical and familial context.

[11] The students were young girls from Polynesia from a socially and economically disadvantaged background.

I took my first steps in the clinical didactics of socially acute questions with Marguerite, an Earth Science-Life Science teacher (ESLS), who invited me to observe a practical session on teaching biodiversity and soil composition. Marguerite is an experienced teacher, graduated with baccalaureate D (mathematical and sciences of nature)[12], and she has pursued scientific higher education. She completed a degree in Life Sciences and Earth Sciences. She teaches courses to children from 6th, 5th, and 4th grades (11-14 years old).

Marguerite introduces herself as a model of appropriation of the recommended content for teaching socially controversial issues. Indeed, the program of scientific disciplines called Life and Earth Sciences (BOEN, 2008) includes education for sustainable development and education for responsibility within the educational goals set out alongside scientific ones. The use of interdisciplinary modes is advised for grasping the complexity of content knowledge that touches on controversial issues in various areas (scientific, ethical, social, among others). The teaching of socially controversial issues and the various types of "education for" programs call for debate in classroom settings.

Is Marguerite a typical ESLS teacher? Is she a *rara avis*? It is true that she does not resemble the science teachers described by Albe (2012), who are reticent about integrating socio-scientific controversial issues into curricula. She does not, however, have a problem being the one who moderates the debate instead of merely being the one who knows the content knowledge she transmits, as do many beginning teachers. To compose with neutrality obligation bring her to give several possible opinions.

Marguerite is singular as clinical didactics shows (Carnus & Terrisse, 2013; Terrisse & Carnus, 2009). This study is not about considering type as a category in the sense of summarizing a set of traits of a human type (physical, psychological, intellectual, etc.), but rather it is about the singular position that each person has who gives an account of the particular manner in which a subjugated, singular, divided subject deals with the act of teaching.

When asked to address the subject of her teaching of content knowledge entailing controversial issues, Marguerite chose to present a practical session on soil animals that she found to be less traditional that the one on floral dissection. She planned to approach this session "with the idea of the beautiful" as she had referred to "decomposition of matter." Having the students observe "the ground soil with a binocular magnifiers" is an activity she particularly likes and that explains her interest in teaching what she teaches to students in the 6th grade (11 to 12 year olds in France): "They were entranced because we saw crystals, we saw that there were animals, I like that, I like showing them things at different scales." To show others what cannot be seen by the naked eye is an essential aspect of teaching ESLS for this teacher. That is what comes through the introductory words she uses to her students at the beginning of the class: "So, we're going to observe animals that we wouldn't have been able to see because so they're so little, really, the teeniest ones we could see with the naked eye like an acarid, we saw it but it was impossible to count how many legs it had" (V38-41). During the session, she drew the children's attention several times to what cannot be seen without an instrument and what can be seen using a magnifying lens: "There,

[12] It has existed from 1968 to 1996 when it was replaced by the Baccalaureate (Scientific) with the new series of general Baccalaureate, ES (Economical and Social) and L (Literary).

it's huge, come and see it (V208[13])"; "You can see the dipluran's digestive tract really well there" (V443).

Observing what cannot be seen is seeing what does not show up to the naked eye, but for Marguerite it is also seeing the beautiful, where an unmagnified view only shows "something ugly": "For example….soon, I'm going to bring in vegetables, vegetable skins when we start to make compost…I like showing them the mold….and that's where I can tie it in to what's beautiful, what's beautiful, what's ugly because just looking at it with the naked eye, it's ugly but with a magnifier, it's beautiful. That's it, I like this" (I180-183[14]).

Marguerite enjoys having her students see the beauty of decomposed matter beyond the disgust that it might cause at first sight: "Yep, because we bring them rotten vegetables, eh, I bring in really decomposed ones, so that stinks, they say ugh, ugh, you hear them shouting out…Ok, so then we get the magnifier and we see the molds, it's so pretty, and these things are things I really like" (I189-193). Teaching students to observe rotten vegetables under a microscope enables them to see the beauty of nature, and, thus, to wanting to preserve it: "It's really important that they observe and that they see that they are really being shown that nature is quite simply beautiful"; "You have to have had a sense of wonder about something in order to want to respect it", she adds at the end of the video recording session.

Seeing the invisible, attempting to "touch" the perceptible world "with one's eyes" (Quinet, 2003) translates the movement by which Marguerite places herself in relation to the world and knowledge, this trait functioning to account for her subjective position. It is also this movement that she uses in teaching the sciences to her students. Thus, the desire to know is grounded in the desire to see, the energy-related trait of which Freud stressed and termed the scopic drive. The epistemophilic drive, or the drive to know (drive of knowledge), is tied to sexual issues for Freud. It arises in the drive to see and the instinct or impulse to mastery. This drive-related hardiness drawing on sources of what is infantile is at work in Marguerite's professional practice. This sublimated drive, is turned towards socially valued objects: science teaching's very own investigative approach. This clinical teaching vignette of "Seeing the beautiful and the invisible" interweaves in this very specific manner the epistemophilic drive, the scopic drive and sublimation. The Marguerite's teaching intention relates to preserving biodiversity. The case study reveals her preservation of her "drive of knowledge" and scopic drive (drive to see).

CONCLUSION

Although the didactics of disciplines is focused on the content knowledge that teaching aims to dispense and is often satisfied with an epistemic subject (Brossais, 2014), the nature of the sets of problems that come under the heading of socially controversial issues leads to disengaging oneself from the epistemic subjects devoid of affect and

[13] The letter V indicate video transcription.
[14] The letter I indicate interview transcription.

centered on cognitive functioning. The theoretical underpinnings are essentially psychological and sociological. Borrowings from psychology permit subjectivity to be viewed from the angle of representations. A number of educators of socially controversial issues are also trained in didactics of science. Marked by a vision of the sciences coming from the sociology of the sciences, they refer to authors who emphasize interactions between the technosciences and social viewpoints. According to their theoretical and epistemological grounding, research into teaching practices regarding socially controversial issues places actors or subjects at the center of their studies, and, consequently, these are studies about single or multiple cases that may be exemplary or singular in nature. These differences show the wealth of questioning that educators of socially acute question didactics examine.

The social constructivist approach is relevant for thinking about environmental citizenship in terms of citizen responsibility about the possible consequences of the technosciences and the development of a critical viewpoint. In this manner of reasoning, Carine Rousseau (2014) puts forth the notion of creativity defined by Lubart (2013, cited by Rousseau) as "the capacity to produce something that is both new and adapted to the context in which it is manifested." The question of creativity is a point of overlap with my research interests. However, Carine Rousseau introduces the term to describe groups of learners. Her assumption concerns the contributions of group creativity to idea generation and collective decision-making. For me, creativity belongs to the teacher who implements teaching scenarios in keeping with the expression of her/his desire. The relationship to uncertainty as the moment of truth where the subject is called upon, is an invitation to think through those stages where knowledge, teacher and student meet in spaces of creativity and invention (Brossais, 2014). The relationship to uncertainty starts a line of question-asking that enables the complexity of the act of teaching, the choices the teacher must make, and the creative spaces that open up to her/him to be studied. The French term *creativité*, introduced by social psychologists from the English word 'creativity,' is often defined as the capacity for discovering a new or original solution to a particular problem. Psychoanalyst Jean-Richard Freyman (2013), writes that "creativity comes about through lack" in the Lacanian sense. He writes on the subject of the relationship of social workers to society, which I think, could be used in reference to teachers:

> A victim of incredible social pressure, he/she also shows the determination not to systematically give into political determinations, and to create something along the lines of a personal message that makes it possible for him or her to inscribe his own singularity in the public space (Freyman, 2013, p. 83).

Based on conceptions or theories of subjects that support the Socially Acute Question didactics project, different ways of questioning may spring up regarding the concepts used such as those of engagement, uncertainty or creativity and, more broadly, the comprehensive and/or praxeological aims of research.

The social constructivist approach is relevant to think eco-citizenship in terms of citizen responsibility about technosciences possible consequences and critical glance development. The responsible terms come from the Latin verb *respondere* (to answer)

meaning differently according to psychoanalysis references. My approach in clinical didactics underlie that every subject is responsible for what comes to him: “to answer for (his choices, his acts, his existence…) by multiple ways of language and answer to … whom? To others, to human community, to other men” (Rouzel, 2002). The usual current strength of psychoanalysis theory is “to support the subject commitment and responsibility, including in the failures of his actions in the talking cure as in educational research”. (Brossais, 2016, p. 16).

The trial constitutes the moment when the subject verify its quality by setting in motion experience’s transmission without being assured of his action’s result. The unpredictable outcome of every transmission thus suppose the contingency is central to that experience. The notion of trial allows questioning the relation and complexity of knowledge, teacher and student, as spaces of creativity and invention (Brossais, 2014). The test-proof opens up a line of questioning to study the complexity of the teaching process, the choices the teacher has to make and the spaces of creativity opened to him.

Admittedly, this concept “relation to trial” associating didactic conversion, subject supposed to known and impossible to bear (Brossais, Jourdan & Savournin, 2017) can be a tool for formation allowing to assist teachers, trainers, education advisers reflection, which is the second research finality of Socially acute Questions described by Alain Legardez in this special issue.

Didactic conversion, subject supposed to known and impossible to bear (Brossais, Jourdan & Savournin, 2017) are dimensions allowing specifying the relation to the concept of “trial”. This emerging concept can be a tool for formation allowing to assist teachers, trainers, and education advisers’ reflection. Thus, it corresponds to the second research finality of Socially Acute Questions described by Alain Legardez in this special issue.

Undoubtedly, in a trainer position on SAQ clinical didactics, my goal is the transformation of the forms of self, based on research. However, I do not adopt an activist posture in the educational community. Activisms consist in transforming students’ identity through research. Activism consists in convincing the actors so that they engage in the militant action in their school education without reducing it to reproduction of gestures or good practices (Lange, 2015). In my opinion, activism is near to compliance without pressure that is an influence process: a sort of students’ manipulation with good intentions. Carter (2013) wish to highlight teachers’ values and believes in a responsible way in their initial training, who would then train their students and encourage same capacities. In contrast with these studies, my aim is not to transform teachers that I met during my research. In the framework of socially acute questions clinical didactics referring to psychoanalysis, I’m focusing on teachers choices in an empathic position with no intention to change theirs acts when they participate in my studies. Indeed, I support the value of their speech, as a product of the subjects associations and the place of the speaker manifestation and not as a simple vehicle of data support. Between an activism aiming to raise actors’ awareness and social justice and a view to produce knowledge without intervention, there is a place to unfold researches relative to Socially Acute Questions and social changes.

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