Fostering critical thinking through peer review between cooperative learning groups

Helena Silva, José Lopes, Caroline Dominguez, Rita Payan-Carreira, Eva Morais, Maria Nascimento & Felicidade Morais

Abstract

Educational policies keep stressing the importance of critical thinking skills for promotion of academic success in Higher Education, to facilitate transition into the labour market and to foster livelong learning. Curricula in Higher Education Institutions gradually meet this necessity, integrating strategies foreseeing the development of critical thought in students. However, at this level, we still commonly found teaching and learning strategies emphasizing a more or less passive knowledge transfer, focusing on the student's ability to memorize information. Peer review and feedback, allied to cooperative work, are important components of active learning and development of critical thinking skills process. It is therefore important to understand the role and influence of feedback provision in peer review activities between cooperative groups. This study analyses the perceptions and attitudes of 27 students in two Masters Courses on the feedback given in peer review activities (between groups), based on their responses to a survey. Results showed, among other aspects, that collaborative work and feedback exchange between groups fostered the contact with different perspectives towards the same situation, and that its critical analysis allowed the students to enhance different skills, the most referred one being the critical thinking.

Keywords:

critical thinking; cooperative learning; peer review.

Desenvolver o pensamento crítico através da revisão entre pares em grupos de aprendizagem cooperativa

Resumo: As políticas educacionais têm vindo a enfatizar a importância do desenvolvimento de competências de pensamento crítico. Estas competências são cruciais para a promoção do sucesso escolar no Ensino Superior, para facilitar a entrada no mercado de trabalho e para apoiar a aprendizagem permanente. Os currículos das instituições de ensino superior têm vindo a responder a esta necessidade, contemplando estratégias para desenvolver nos estudantes a capacidade de pensar criticamente. Contudo, neste nível de ensino continuam a privilegiar-se estratégias que enfatizam a transferência de conhecimento mais ou menos passiva, com foco na capacidade do estudante memorizar informações. A revisão entre pares e o feedback aliados ao trabalho cooperativo são componentes importantes para uma aprendizagem ativa e para o desenvolvimento das competências de pensamento crítico. Por isso, é importante compreender o papel e a influência de dar feedback em atividades de revisão entre grupos cooperativos. Neste estudo analisam-se as perceções e atitudes de 27 alunos de dois cursos de mestrado sobre o feedback dado em atividades de revisão entre grupos de pares, com base nas suas respostas a um questionário. Os resultados mostraram, entre outros aspetos, que o trabalho colaborativo e o feedback entre os grupos promoveram o contacto com diferentes perspetivas em relação à mesma situação, e que a sua análise crítica permitiu aos alunos, no seu entender, melhorar diferentes competências, sendo a mais referida a do pensamento crítico.

Palavras-chave: pensamento crítico; aprendizagem cooperativa; revisão entre pares.

Développer la pensée critique à travers la révision par les pairs et en groupes d'apprentissage coopératif

Résumé: Les politiques éducatives récentes soulignent l'importance de développer des compétences de pensée critique. Ces compétences sont essentielles pour favoriser la réussite scolaire dans l'enseignement supérieur, faciliter l'entrée des étudiants dans le marché du travail et soutenir l'apprentissage continu. Les programmes des établissements d'enseignement supérieur essayent de répondre à ce besoin, en contemplant des stratégies éducatives qui visent à développer chez les élèves la capacité de penser de façon critique. Toutefois, à ce niveau d'éducation, on continue de donner la priorité à des stratégies qui mettent l'accent sur le transfert des connaissances, en privilégiant la capacité des élèves à mémoriser des informations.
La révision par les pairs et la rétroaction (feedback) alliées au travail coopératif sont des éléments importants d'apprentissage et de développement actif des compétences de la pensée critique. Il est donc indispensable de comprendre le rôle et l'influence de l'apport du feedback aux activités de révision entre groupes coopératifs. Cette étude analyse les perceptions et les attitudes de 27 élèves de deux masters sur le feedback donné lors d'activités de révision par de groupes de pairs, issues de leurs réponses à un questionnaire. Les résultats ont montré, entre autres aspects, que le travail et le feedback collaboratifs entre les groupes ont favorisé le contact avec des perspectives différentes à l'égard de la même situation, et que son analyse critique a permis aux étudiants d'améliorer certaines de leurs compétences, la plus soulignée étant la pensée critique.

Mots clés: pensée critique; apprentissage coopératif; révision par les pairs.

Desarrollar el pensamiento crítico a través de la revisión por pares en grupos de aprendizaje cooperativo

Resumen: Las políticas educativas han venido a subrayar la importancia de desarrollar competencias de pensamiento crítico. Éstas son cruciales para promover el éxito académico en la educación superior, facilitar la entrada en el mercado laboral y apoyar el aprendizaje a lo largo de la vida. Los planes de estudio de las instituciones de educación superior intentan responder a esta necesidad, contemplando estrategias para desarrollar en los estudiantes la capacidad de pensar críticamente. Sin embargo, en este nivel de la educación, se sigue dando prioridad a las estrategias que hacen hincapié en la transferencia de conocimientos, centradas en la capacidad del estudiante para memorizar información.
La revisión por pares y el feedback juntamente con el trabajo cooperativo son componentes importantes para un aprendizaje activo y para el desarrollo de habilidades de pensamiento crítico. Por tanto, es importante entender el papel y la influencia del feedback dado en las actividades de revisión por pares entre grupos cooperativos. Este estudio analiza las percepciones y actitudes de 27 estudiantes de dos cursos de máster de enseñanza a través de sus respuestas a una encuesta sobre las actividades de revisión por pares (entre grupos). Los resultados mostraron, entre otros aspectos, que el trabajo y el feedback de intercambio colaborativo entre grupos fomentaron el contacto con diferentes perspectivas hacia la misma situación, y que su análisis crítico permitió a los estudiantes mejorar habilidades diferentes, especialmente la de pensamiento crítico.

Palabras clave: pensamiento crítico; aprendizaje cooperativo; revisión por pares.

Introduction

Employers are very critical on young people's readiness to enter the labour market. They consider that many employees do not possess the knowledge and skills to be competitive in a rapidly changing world. Today, critical thinking skills are crucial in multiple areas other than to smooth the entrance into labour market, namely to foster the academic success in Higher Education (HE) and to support lifelong learning. However, supporting previous reports (Arum & Roksa, 2014), experts recently reported that a deficit still exists in this sort of skills in newly graduates (Blättler, Rapp, Solà, Davies, & Teixeira, 2013). For these authors, a large proportion of students reach the labour market deprived of skills to analyse and solve problems or to propose innovative solutions, despite possessing the scientific and technical core skills necessary to the profession they selected.

Development of CT remains underestimated in most curricula, despite being contemplated within the educational policies; also, teaching and learning strategies continue to rely on a more or less passive knowledge transfer, focusing on the student's ability to memorize information. The curricula of educational institutions sought to provide strategies to develop the ability to think critically, as it has been proposed for long (e.g., Ennis, 1996).

CT definition changes with authors, and so a variety of non-consensual definitions may be found. Still, all of them agree on the core competencies needed to become a critical thinker: the identification of the problem, the selection and analysis of relevant information, the recognition of inferences, the formulation of hypothesis, the drawing of conclusions and the establishment of judgement on the inferences (Ennis, 2011) which should be completed with the ability for an effective decision making (Ennis, 1996). In brief, CT plays a central role in decision-making, innovation, entrepreneurship and problem solving (Butler, 2012).

McCollister and Sayler (2010) defend that CT may be infused in all subjects using diverse learning strategies, including the online discussion forums (Snodgrass, 2011), in-class discussions (Lopes & Silva, 2010), cooperative learning strategies (e.g. Bauer, Figl, Derntl, Beran, & Kabicher, 2009), or the use of alternative assessment styles, like peer evaluation (Karandinou, 2012; Yu & Wu, 2013).

Cooperative learning (CL) is a helpful active pedagogy fostering the acquisition of knowledge and of personal and social skills resulting from the collaboration between the teacher and students, and among students in their working teams (Tsay & Brady, 2010). The benefits and difficulties of peer review and feedback provision have been studied (Nelson & Schunn, 2009; Boase-Jelinek, Parker, & Herrington, 2013). Our previous experiences in engineering courses also evidenced the impact of individual web-based peer review on written

documents as a learning facilitator and promoter of communication and critical reasoning (Dominguez et al., 2015), although the proposed activities also increased the teacher workload related to the support given to students, which remains an important drawback. Developing the activity using cooperative groups (CG) could help mitigating this issue.

CL is often defined as a pedagogical strategy where small, heterogeneous groups of students are requested to work together for a given period to accomplish shared learning goals, fulfilled if all group members are committed to their assignments (Johnson, Johnson & Smith, 2014). This learning approach has been associated to increased students' achievement and knowledge retention (Johnson & Johnson, 2009). Students encourage and support each other, assume responsibility for their own and each other's learning, employ group related social skills, and evaluate the group's progress (Dotson, 2001). Working together also promotes the students' skills for their learning autonomy (Lopes & Silva, 2010; Zimmerman, 2000).

The teacher assumes the role of facilitator enabling the students' progressive autonomy (Slavin, 1995), and enhances the interactive process intra and inter-groups as well as the development of analytical, synthesis and evaluative skills in face of presented arguments and opinions (Johnson & Johnson, 2009). Peer review itself is a process used as a learning enabler in various domains, in CL contexts (Yu & Wu, 2013), as well as to strengthen students' CT skills (Dominguez et al., 2015). It allows and encourages students to take an active role in managing their own learning (Pearce, Mulder & Baik, 2009). As a cooperative tool, it promotes skills related to diagnosis, evaluation, synthesis and communication (e.g. Bauer et al., 2009). When performing the review of their colleagues' work, students actively participate in the overall learning process (Karandinou, 2012). They have the opportunity to interact with different perspectives and opinions, analyse critically the ideas, comment, compare the work, give and receive feedback that can be used to enhance their own work, besides enabling peer feedback on the students' activities (Ozogul & Sullivan, 2007). A similar outcome would be anticipated from the application of the same framework to CG of three or four students (inter-group review). Information on the use of activities involving peer review and giving feedback in small groups of three or four students is scarce. Gillies (2004) observed a positive effect of the development of CL strategies in structured students' groups, since in those groups there is a stronger team interrelationship and social willingness to accept responsibility in teaching each other. When peer review is joined with CG work, students are required to regulate their individual behaviour in accordance with the goals of the team introducing additional dynamics. So, it is also

important to understand the role of group feedback in team's performance, during cooperative activities designed to strengthen CT skills.

From our previous findings, and being aware of the potential of CG learning and of peer review, we decided to analyse the effects of the activity involving peer review and feedback provision on the development of CT skills when the activity is performed between CG. Thus, we aim to contribute to an unexplored field.

Using a web-based cooperative writing environment and a CG peer review approach, the authors aimed to determine the effect of cooperative learning on CT development in two Master's Courses of Teaching at University of Trás-os-Montes e Alto Douro, in Portugal. The present paper intends: to use the analysis of the students' perceptions to identify the developed CT skills during peer review activities; to examine students' perceptions towards the feedback between CG; and to identify students' individual opinion on the usefulness and quality of the received feedback.

Method

Research Design

This study involved 27 Master students: 12 students, all females, aged from 21 to 33, came from the Pre-scholar Education and 1st cycle of Basic Education Master; 15 students, aged from 21 to 29, 87% females, came from the 1st and 2nd cycles of Basic Education Master.

The CG activity was developed in these two groups of students, focusing on one component of the syllabus: Environmental Sciences Teaching. The goals for this particular component syllabus were to familiarize students with the cooperative learning methodology, with the importance and the usefulness of a good feedback in teaching and learning activities. Students were meant to reinforce the competencies of writing, synthesis, analysis, interpersonal communication, collaborative work, and CT.

All the students were organized in CG of three or four individuals. In-class, the groups examined scientific papers selected by the teacher, following the approach described in Dominguez et al. (2015). Their written output was subsequently submitted to peer review by a different group. The activity was scheduled as follows:

1) 1st session - all the groups played the role of "student-authors". Each group of students collaboratively produced a written document, containing a synthesis and an analysis of the paper (chosen by the teacher) using the Ennis' six dimensions FRISCO guidelines (Ennis, 1996) as outlined in Dominguez et al. (2015), in a Google Drive Doc (digital) template designed by the teacher ;

2) 2nd session - papers were blindly switched between groups. At this time all the groups were "student-reviewers". They should review the work of their peers' group and collaboratively give their opinion using the same guidelines and the model of a good feedback (Nelson & Schunn, 2009);

3) 3rd session – each "student-author group" had to collectively consider/argue their peers' group feedback and use it to improve (or not) its work (within the same template);

4) 4th session - each student anonymously and individually filled an online (Google Drive Form) questionnaire on the activity..

Measures

The satisfaction survey, divided in four parts, included closed and open-ended questions. The first part aimed to identify the importance students attributed to their roles as authors, to evaluate the utility of the FRISCO guidelines and the perceived importance and quality of received feedback for the improvement of their written assignment (19 questions, with 32% open-ended, OE). The second part elicited the general opinion on the activities engaged to strengthen CT skills (14 questions, with 36% OE). Closed questions that identified particular skills demanded that students justify their choices in open questions, to minimise putative biases. The third part focused on the opinion of reviewer-students about their ability to provide a quality feedback and on the characteristics of the feedback provided (18 questions, with 22% OE).

Procedure

For this work, we selected nine questions on the feedback for the role of students as authors, seven questions for the students as reviewers, and six questions regarding students' perceptions, opinions and reasons about the acquired skills. Data from closed-ended questions were examined using percentages in the group. Answers to OE questions were evaluated through content analysis.

Results

Data presented below were extracted from the students' final survey assessing the 27 students' perceptions about the CT activity. In particular, it represents the information from the answers to questions related to the influence of the cooperative methodology (inter-group review) and to the quality of feedback on the skills acquired with this work.

In their role as authors, 96% of the students liked/liked a lot being evaluated by their colleagues. Analysing their answers on the reasons underlying this

evaluation, 85% of students agreed that feedback allowed detecting aspects to improve and to interact with different ideas and opinions (35%), as exemplified below.

> "When we are evaluated by peers we have better perception of what we did wrong and what can be changed and corrected; also, we get opinions from another person who has done the same work (…)";
> "I agree, because we must always listen to others and respect their opinions. In addition, it allows us access to new ideas and strategies that can be adopted to improve our work";
> "Because it is a way to compare our ideas with those of others, allowing change, reorganization or improvement."

As authors, all students accepted and used the feedback received. The three main reasons provided were that they received constructive feedback (63%); helped them to reflect on the work and to improve it (78%), as well as to contact with other valid points of view (26%). Some of the students' arguments are presented below.

> "I used it because the feedback from my colleagues was always positive and constructive. It helped me to always improve my work, giving a logical sequence of ideas and arguments that led me to reflect and change some errors in my work".
> "If the pairs did not understand some issues, then the work/document was not clear. I have accepted the feedback because it allowed me to draw to new conclusions after having considering the others´ ideas".

All of the students stated that they received feedback including a summary with an overall analysis of their work, identifying possible errors and failures, and including recommendations for improvements and solutions. 67% of them considered the feedback as constructive, while for 22% it was positive and motivational, for 4% it was insignificant (superficial, without relevant comments) and for 7% it had negative critics of comments on their work. Most students (78%) agreed/strongly agree that the feedback was detailed and presented arguments and a logical sequence of ideas, even if they were not always clear. The majority (78%) also considered the fairness of feedback because it was coherent and reflected the work they performed. Most students (82%) stated that they used the feedback to solve the errors or failures identified by their colleagues. All the students used the feedback given by their colleagues and agreed/strongly agreed that it was detailed and clear; considering the overall assessment made by the reviewer-groups to their feedback, 78% of the "authors-groups" considered it effective.

On regards to the role of reviewers, 74% of the students liked/liked very much assessing other groups-work, which was due to the feeling that revision activity

allowed them to develop several skills. CT was the most mentioned skill (15%). One-third (33%) of the students also considered that their feedback helped to improve the peers' work. About 15% of students believed that the reviewing process allowed them to seek different perspectives and thereby acquired more autonomy in the learning process. These are examples of the students' opinions:

> "It allowed me to develop argumentation and counter-argumentation skills. It helped me to reflect on what is CT and how to develop it";
> "Because it is very important to show our opinions to colleagues, not only because it allow to develop our CT, but also because it help them to improve less positive aspects [of their work] ";
> "I think that my peers when confronted with my revision, will be able to consider other aspects that they might not have seen before, which would allow them to improve the conclusions for their work".

Students that disliked the reviewer role (7%) presented the fear of being unfair to the colleagues because assessing other's work was difficult. Yet, concerning their role as reviewers, 56% of the students believed they were equally skilled as the teacher to assess their colleagues, contrasting with 11% of the students who disagreed with this opinion, while 33% were indifferent.

Students referred that the feedback provided to their colleagues included a summary with a general appreciation of their work (67%), with the identification of errors and failures, and included suggestions for improvement. They perceived the feedback provided as constructive (59%), encouraging to find new, positive and motivational solutions (33%). 63% of students checked the use of provided feedback and the changes introduced by the authors when revising the document.

Summarizing, students' opinions were coherent in both roles, either as authors or as reviewers: most students (41%) preferred the role of reviewers rather than authors, whereas 33% were indifferent to the role-played, and 26% enjoyed more being authors than reviewers. Some of the students who preferred to be authors considered this role more interesting and helpful for developing more skills, such as synthesis, sharing their own ideas, and enhance their argumentation skills. A student wrote: "I developed more capabilities as author; being reviewer, I only gave feedback and recommendations. Being an author, I developed synthesis skills, and gave feedback and argued". From the remarks used by students that preferred the author-role, 7.4% included the fear of a possible negative reaction of their peers toward the feedback provided and by the fact that this role is easier than that of a reviewer. They also consider that it was easier to present their point of view, than to assess those of others when giving feedback. As an example:

> "The author role does not demand to revise and provide feedback on other´s work, a task I still have some difficulties to accomplish. Nevertheless, when

playing the role of reviewer, we actively apply CT skills because we can discuss our opinions with our peers".

Students that preferred the role of reviewers valued the opportunity to contact with different perspectives and ponder them in their own work, supporting the references on the use feedback in their work, which may provide a good indication for this auto-regulation skill. They also state that the reviewer role strengthened more their CT skills and attention, as in the example below:

> "I rather liked being reviewer as I found other point of views concerning the abstract and the FRISCO guidelines, which allow me to understand which parts of my work needed improvement, also the fact that we are called to correct and to provide feedback".
> The further development of skills was also the reason for students liking to play both roles. Some of them distinguished between the skills developed as authors or as reviewers. As authors, they developed synthesis skills, and as reviewers, they focused the importance on providing feedback. CT development emerges as a related ability, in their roles as authors and as reviewers. One student stated that he preferred the reviewer role as he considered "(...) *more interesting reviewing and commenting than performing the initial step of the assignment*". Contrasting, other students made the comments below.
> "*It's good to be on both sides, because as author I experienced to identify in a paper all important aspects and develop my CT. While as reviewer it is also very important because I gave constructive feedback to the other group so that they can improve while I also develop my own critical thinking*";
> "*Both roles are interesting ... Both are important experiences in the development of CT*".

Globally, 93% of the students considered the activity satisfactory/very satisfactory, and 89% agreed/strongly agreed that the peer review activity increased their CT skills. About 93% of them agreed/strongly agreed that the peer review activity was important for their training, and also considered that it allowed them to improve their synthesis and CT skills. Moreover, 89% thought that the activity improved their sense of accountability; all of them felt they improved their collaboration skills and their respect for others' opinions. Below are presented several students' views:

> "I entered a group where the work has always been developed with great commitment by all members, where we collaborated, we respected different opinions, helped everyone, and we developed all the skills of critical reflection and synthesis, as we did everything so we could all achieve our goals";
> "It allowed the discussion of different ideas and allowed me to develop the ability to accept different opinions";
> "Because it was an activity designed to learn and develop CT, cooperation, reflection and accountability skills, among others...";
> "Due to the cooperation among the students involved in this activity";
> "It allow the development of argumentation skills and to share different knowledge and opinions".

When questioned if they were to maintain the activity with the same framework, 96% would choose to do it again in cooperative groups, because it developed several cognitive and social skills (60%). The most referred cognitive skills were the analysis (27%), synthesis (27%), and CT (45%). The most mentioned social skills were collaboration (22%), mutual aid (33%), sharing (54%), and also the exchange of ideas allowed by working in cooperative groups (45%). See students' comments below:

> "As a group we have more opportunities to exchange ideas and opinions, so we can structure a better answer";
> "I consider that group-working develops very important skills such as respect for the others' opinions, and it also develops cognitive conflicts and allows everyone to learn better";
> "When performing our revision, we simultaneously openly discuss and exchange ideas, which originates a more critical and sound peer-review. To us, while we exchange opinions we are also working our abilities to critically think and to listen and accept the point of view of other teammates".
> "We can discuss and compare different ideas within the group, and even to correct them. It is possible that some times individual differences may compromise the outcomes, but more often there are more positive than negative issues in collaborative work; since cooperation emerges from it, as well as the respect for the colleagues and their opinions".

We associated the inferred categories emerging from the analysis to some CT cognitive skills (Ennis, 1996 and 2011) to the responses to the students' perceptions questionnaire, as depicted in Figure 1.

Cognitive skills – categories emerged

Evaluation
- To identify the points or issues needing to be improved
- To become more authonomous in the learning process

Synthesis
- To receive (constructive) feedback and use it to improve the work
- To consider new perspectives concerning the improvement of the work
- To reflect on the work and to identify issues to be corrected

Analysis
- To interact with different oppinions or ideas
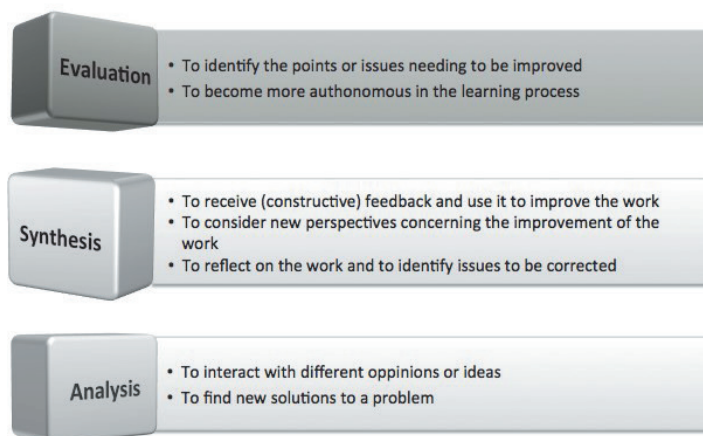- To find new solutions to a problem

Figure 1. Cognitive skills and inferred categories issued from the content analysis

Discussion and Conclusions

This study attempts to show that, according to the students´ perceptions, cooperative peer review activities develop various cognitive and social skills. The methodology used was motivating and important for students' professional training since students attending Teaching Masters performed this activity. The peer review activity in CG seems to have produced good results, confirming other studies which show that feedback given and received significantly contributes to improve the individual work and some CT skills (Ozogul & Sullivan, 2007; Dominguez et al., 2015). This study shows that students perceived to have gained analytical skills, one of the CT skills listed by Ennis (2011). Additionally, the content analysis of the students´ answers evidenced that peer review in cooperative environment allowed students to improve their final work, thus reflecting their ability to evaluate and create, as well as to contact with different opinions.

Feedback resulting from discussion of teammates' opinions was reported as richer or more complete. All participants, both as authors or reviewers, revealed very positive attitudes and perceptions about the feedback in a cooperative environment and agreed that changing the roles was important. Their opinions also positively highlighted the development of cognitive and social skills, which led all students to agree that if they had to choose again to perform the activity they would do it according to this CG framework. Those opinions are in line with other works that discuss the benefits of CG (Dotson, 2001; Johnson et al., 2014). Either as authors, or as reviewers, students used the feedback given by their peers to improve their work. They found it constructive, helped them to reflect on the shortcomings of their own work enabling them to improve it, thus showing their acceptance of the responsibility for teaching each other (Gillies, 2004). With this activity, feedback allowed students to contact with general and specific analysis of their work and the feedback quality was generally considered as good as the one provided by the teacher, as stressed also by Ozogul and Sullivan (2007). In either role, students claimed to have developed CT as a general skill, from giving feedback, and specifically skills of synthesis, argumentation and counter-argumentation, integration and respect for different perspectives and views, individual accountability, acceptance of different opinions and learning autonomy (Dominguez et al., 2015; Lopes & Silva, 2010; Zimmerman, 2000).

This work only reflects the perceptions of the students. Since the population was small, it may somehow weaken the results. In further studies, we intend to include results on the cognitive gains through the analysis of the contents of

the written interactions produced by the students and to involve a higher number of students. The role of the teacher in peer review and feedback applied in collaborative learning strategies was not addressed in this work, an aspect that will be focused in the future, along with a comparison of the quality of the feedback provided by teacher *vs.* students.

Acknowledgments

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Helena Silva
Professora associada na Universidade de Trás-os-Montes e Alto Douro,
Vila Real, Portugal, www.utad.pt
Escola de Ciências Humanas e Sociais, Departamento de Educação e
Psicologia
CIIE - Centro de Investigação e Intervenção Educativas, Faculdade de
Psicologia e Ciências da Educação, Universidade do Porto, Porto, Portugal

Email: helsilva@utad.pt

José Lopes
Professor associado na Universidade de Trás-os-Montes e Alto Douro,
Vila Real, Portugal, www.utad.pt
Escola de Ciências Humanas e Sociais, Departamento de Educação e
Psicologia
CIIE - Centro de Investigação e Intervenção Educativas, Faculdade de
Psicologia e Ciências da Educação, Universidade do Porto, Porto, Portugal
Email: jlopes@utad.pt

Caroline Dominguez
Professora auxiliar na Universidade de Trás-os-Montes e Alto Douro, Vila
Real, Portugal, www.utad.pt
Escola de Ciência e Tecnologia, Departamento de Engenharias
LabDCT/CIDTFF - Laboratório de Didática de Ciências e Tecnologia
/ Centro de Investigação Didática e Tecnologia na Formação de
Formadores, Universidade de Aveiro, Aveiro, Portugal
Email: carold@utad.pt

Rita Payan-Carreira
Professora auxiliar com agregação na Universidade de Trás-os-Montes e
Alto Douro, Vila Real, Portugal, www.utad.pt
Escola de Ciências Agrárias e Veterinárias, Departamento de Zootecnia
CECAV - Centro de Ciência Animal e Veterinária, Universidade de Trás-os-
Montes e Alto Douro, Vila Real, Portugal
Email: ritapay@utad.pt

Eva Morais
Professora auxiliar na Universidade de Trás-os-Montes e Alto Douro, Vila
Real, Portugal, www.utad.pt
Escola de Ciência e Tecnologia, Departamento de Matemática
CEMAPRE - Centro de Matemática Aplicada à Previsão e Decisão
Económica, Instituto Superior de Economia e Gestão, Universidade de
Lisboa, Lisboa, Portugal
Email: emorais@utad.pt

Maria Manuel Nascimento
Professora auxiliar na Universidade de Trás-os-Montes e Alto Douro, Vila
Real, Portugal, www.utad.pt
Escola de Ciência e Tecnologia, Departamento de Matemática,
LabDCT/CIDTFF - Laboratório de Didática de Ciências e Tecnologia
/ Centro de Investigação Didática e Tecnologia na Formação de
Formadores, Universidade de Aveiro, Aveiro, Portugal

Email: mmsn@utad.pt

Felicidade Morais
Professora auxiliar na Universidade de Trás-os-Montes e Alto Douro, Vila
Real, Portugal, www.utad.pt
Escola de Ciências Humanas e Sociais, Departamento de Letras, Artes e
Comunicação
CEL - Centro de Estudos em Letras, Universidade de Trás-os-Montes e
Alto Douro, Vila Real, Portugal; CELGA - Centro de Linguística Geral e
Aplicada, Universidade de Coimbra, Portugal
Email: mmorais@utad.pt

Correspondência
Helena Silva
CIIE - Centro de Investigação e Intervenção Educativas, Faculdade de
Psicologia e Ciências da Educação, Universidade do Porto, Porto, Portugal
Universidade de Trás-os-Montes e Alto Douro (UTAD),
Escola de Ciências Humana e Sociais, Departamento de Educação e
Psicologia. Quinta de Prados, 5001-801 Vila Real, Portugal