

科技部補助專題研究計畫報告

國小科學教師書面回饋之性別差異：學生知覺、教師觀點與教師實踐之研究(第2年)

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本研究具有政策應用參考價值：否 是，建議提供機關
(勾選「是」者，請列舉建議可提供施政參考之業務主管機關)
本研究具影響公共利益之重大發現：否 是

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中文摘要：過去研究已確認，有效的教師回饋對學習和教學的重要，以及性別因素對師生互動的影響；然而，性別、科學教師書面回饋以及學生知覺的書面回饋之間的關係，仍有待進一步研究。男性和女性科學教師對回饋的觀點和實踐可能存在差異，不同性別的學生教師的書面回饋也可能會有不同的知覺。因此，瞭解科學教師書面回饋的性別差異是本研究的重點，待答問題包括：（1）科學教師是否對男性和女性學生提供不同的書面回饋？（2）男女學生是否對科學書面回饋有不同的知覺？（3）男女科學教師是否對學生提供不同的書面回饋？（4）男女科學教師是否對書面回饋有不同的觀點？以及（5）性別、教師實踐、教師觀點和學生對科學書面回饋的知覺之間的有何關係？

本研究將採取社會文化觀點，以各種方式考慮科學書面回饋中的性別問題。本研究參與者包括國小自然科教師、這些教師的學生，以及學生的自然與生活科技習作和作業。本研究使用的工具包括教師書面回饋的編碼系統、學生對教師回饋知覺的問卷，以及半結構式的教師訪談指引。在收集資料之前，研究者進行研究工具之信度與效度分析。為了回答本研究問題，研究者將進行不同之資料分析，包括學生習作與作業的內容分析、學生問卷調查資料的統計分析，以及教師訪談的質性資料分析。研究結果發現，雖然教師知覺的書面回饋實踐面並無差異，然而在批改科學作業時給予學生回饋方面，女性教師批改符號以打勾和等第為主，男性教師則以蓋獎勵章和書面評語為主。而在學生知覺教師書面回饋方面，女學生傾向認為教師提供符號或正確答案對科學學習較有幫助，男學生則傾向認為教師針對其錯誤提供解釋較有幫助。本研究根據結果進一步提出研究建議。這項研究的貢獻將是深化我們對“有效教師回饋”的性別因素之理解，以利教師洞察性別對科學學習的影響，並進一步提升女性學生的科學學習參與、興趣與自信。

中文關鍵詞：書面回饋、科學學習、性別差異

英文摘要：Teacher feedback has been considered as a critical strategy in teaching and learning (e.g., Black & Wiliam, 1998a, 1998b; Bell & Cowie, 2001; Hattie & Timperley, 2007; Shute, 2008; Tunstall & Gipps, 1996). Considering the effect of gender in teacher-student interactions, however, little has been known about the role of gender in teachers' written feedback and students' perceptions of written feedback in science. Science teachers' written feedback may be differently perceived by male and female students. Therefore, differences in elementary science teachers' written feedback depending on gender are the focus of the study. More specifically, the research questions of this study to be answered are: (1) Do science teachers provide written feedback to male and female students differently? (2) Do male and female students perceive science written feedback differently? (3) Do male and female science teachers provide written feedback to students differently? (4) Do male and female science teachers perceive written

feedback differently? and (5) What is the relationship among gender, teacher practices, teacher perspective, and student perceptions on written feedback?

A socio-cultural perspective was applied with which gender comes into view in a variety of ways via written feedback. Participants in this study involved two elementary sciences teachers (one male and one female), their students, and students' science workbooks and assignments. Instruments used in this study included a coding system of teacher written feedback, a survey of students' perceptions of teacher written feedback, and a semi-structured teacher interview guide. Quality of the instruments in terms of reliability and validity was evaluated before the data collection. To answer the research questions, data collected were analyzed via content analysis from students' workbooks and assignments, statistical analysis from students' survey data, and qualitative data analysis from teacher interviews.

The results demonstrate that science teachers in this study perceived assessment of written comments was more helpful for student learning than assessment in general.

Furthermore, female teacher was found to provide more check marks and grades and less symbols/stamps and written comments than male teacher. In terms of students' perceptions on written feedback, female students tended to think it is more helpful when their teachers provided marks and/or correct answers when they found an error on the work and male students tended to think it is more helpful when their teachers provided explanations on an error of the work. However, the results need to be further confirmed with data from more students. The contribution of this study is to enrich our understanding of the meaning of 'effective feedback' when related to gender, to provide insight with teachers from the start of their profession for the effects of gender over time on science learning, and further to make contribution to female students' learning in science.

英文關鍵詞：written feedback, science learning, gender differences

Gender Differences in Elementary Science Teachers' Written Feedback: Students' Perceptions, Teachers' Perspectives and Practices

Introduction

Research has showed that although there are no gender differences in math or science until teenage years, women are underrepresented in college science majors and careers in science (Barton, Tan, & Rivet 2008; Brickhouse, Schultz, & Lowery 2000; Brickhouse & Potter, 2001; Carlone, 2004). This suggests that socialization may contribute to explain these differences and school is one of the critical contexts in which the socialization develops.

Meanwhile, research indicates that male students have more opportunities to experience science both inside and out of classrooms. Beside science experiences, male students are also found to have more positive attitudes and interests toward science than female peers who have less self-confidence in science. The development of interests and attitudes toward science may affect college major and career selection for all students. Thus, there is a need to understand how female students experience science differently in school, including elementary schools (Ivinson & Murphy, 2007; Shaw, 1995; Walkerdine, 1998).

Ramaprasad (1983) defines feedback as “information about the gap between the actual level and the reference level of a system parameter which is used to alter the gap in some way”. The effect of feedback was found significant; however, the elements of feedback that support student learning remain understudied (Black & Wiliam, 1998a, 1998b; Bell & Cowie, 2001; Hattie & Timperley, 2007; Sadler, 1989). The purpose of this study is to examine gender differences in teachers' and students' perceptions on teachers' written feedback and in teachers' actual feedback practices in order to understand whether there are differences in teacher treatment to male and female students in science classes. It is critical to understand the role of feedback in contributing to gender differences in attitude or science achievement. If teachers treat students differently in science classes, this differential treatment may affect the decisions the student makes about their future education and careers.

A sociocultural perspective was applied in this study to understand how male and female students access to cultural tools and resources as they participate in science classroom activities. In Vygotsky's (1987) sociocultural theory of learning, “knowledge is viewed as to be constructed in a social context, such as classroom, through language and other semiotic means”. Teachers can assist student performance through the “zone of proximal development” to support student learning. The study is particularly interested in the way gender emerges spontaneously in teacher feedback practice. By focusing on the everyday classroom practice, it intends to further understand why female students, in comparison to male peers, are further underrepresented in college science majors and careers in science.

According to Hattie and Timperley (2007), feedback is ‘information provided after instruction that seeks to provide knowledge and skills or to develop particular attitudes’. The authors identified three major feedback questions: ‘how am I going?’, ‘where am I going?’ and ‘what to do next?’, reflecting the critical connection between assessment and learning. Written feedback has been found to be effective in elementary classrooms. Orsmond and Merry (2011) classified written feedbacks into the following categories: “identifying errors, giving praise, correcting errors, explaining misunderstandings, demonstrating correct practice, engaging students in thinking, suggesting further study, justifying marks, and suggesting approaches to future assignments”. Research has found that written comments in homework were effective on students’ attitudes toward the subject (Elawar & Corno, 1985). However, other factors that may influence the effect of written feedback, such as the content of the feedback or how students perceive and utilize feedback from their teachers, were still unclear in literature.

Teachers’ expectations toward students have been found to be important to students’ achievement in science (Huang & Fraser, 2009; Kahle & Meece, 1994; She & Fisher, 2002). Although studies showed that science teachers may provide instruction that showed different expectations toward students in different genders. Consequentially, male and female students may receive somehow different education through teachers’ different treatment in school (Chapman, 2002; Kahle & Meece, 1994; Sadker, 1999). These different expectations in science may result in gender differences in learning outcomes self-esteem in female students (Sadker, Sadker, & Klein, 1991; Sadker & Sadker, 1995; Sadker, 1999; Shelley, 2000; McCormick, 1995; Carli, 1999).

The literature review above reveals that research on gender in science education has followed several different paths, but few studies have looked at the relationships between gender and teacher written feedback. An exploration of gender in relation to the reception of written feedback is the focus of the study. This study is interested in the possibility of potential gender differences in the way teachers present written feedback to students and students perceive the feedback from teachers.

Research Questions

In order to better understand science teachers’ written feedback and to understand male and female students’ perceptions of teacher feedback, this study considers written feedback alignment in the context of classrooms. It addresses the following research questions:

- (1) Do elementary science teachers provide written feedback to male and female students differently?
- (2) Do male and female elementary students perceive written feedback differently?
- (3) Do male and female science teachers provide written feedback to students differently?
- (4) Do male and female science teachers perceive written feedback differently?

(5) What is the relationship among gender, teacher practices, teacher perspectives, and student perceptions of written feedback in science?

The study aims to understand of the role of written feedback on student science learning in different genders. A mixed-method approach is chosen to understand students’ perceptions of written feedback they receive during their science classes. The findings can inform the education and assessment community about how teachers’ written feedback and goals motivates female student learning.

Methods

Based on the literature review, this study asks the following research questions about gender and science written feedback in elementary schools: (1) Do science teachers provide written feedback to male and female students differently? (2) Do male and female students perceive science written feedback differently? (3) Do male and female science teachers provide written feedback to students differently? (4) Do male and female science teachers perceive written feedback differently? and (5) What is the relationship among gender, teacher practices, teacher perspectives, and student perceptions of written feedback in science? This section describes participants/sample, instruments, data analysis, and procedures of this study, which are summarized in Table 1.

Table 1 Summary of the Methods Section in this study.

Research Question	Do science teachers provide written feedback to male and female students differently?	Do male and female students perceive science written feedback differently?	Do male and female science teachers provide written feedback to students differently?	Do male and female science teachers perceive written feedback differently?
Participants / Sample	Students’ workbooks	Students	Students’ workbooks	Teachers
Instrument	Coding system	Questionnaire	Coding system	Semi-structured Interview
Data Analysis	Content analysis Statistical analysis	Statistical analysis	Content analysis Statistical analysis	Qualitative data analysis

Participants

Science teachers. In order to make the data collected comparable, elementary science teachers in elementary schools are the target participants in this study. Two science teachers in two different

elementary schools participated in this study. Purposive sampling will be used to recruit the teachers. The teachers recruited were interviewed with a semi-structural survey. Beside information about written feedback, background information was also collected, including gender, year of teaching, education level, school location, number of classes taught, and average number of students in a class. Table 2 provides general information about the teachers.

Elementary students. The students of each science teacher were selected and asked to fill out the survey in order to understand their perceptions of teacher written feedback in science.

Science workbooks and assignments. For each of the science teachers, six students were sampled from class to whom they have provided individual written feedback, in which there were three male and three female students. Among each gender, there were one high-, one medium-, and one low-achievement student in science. No instructions were provided to the teachers on how to use or what to include in the students' science workbooks. The science workbooks and assignments of the students were collected for content analysis.

Design and Procedures

This study utilized a mixed methodology approach in which content analysis of written feedback provided by teachers was compared with quantitative survey data from students and qualitative interview data from teachers to enable relationships to be sought among gender, the actual nature of the feedback provided, teachers' intentions for feedback, and students' perceptions of the feedback. The procedures of this study included the following three stages: instrument development, data collection, and data analysis (see Figure 1). The details of each stage were described in the later corresponding sections.

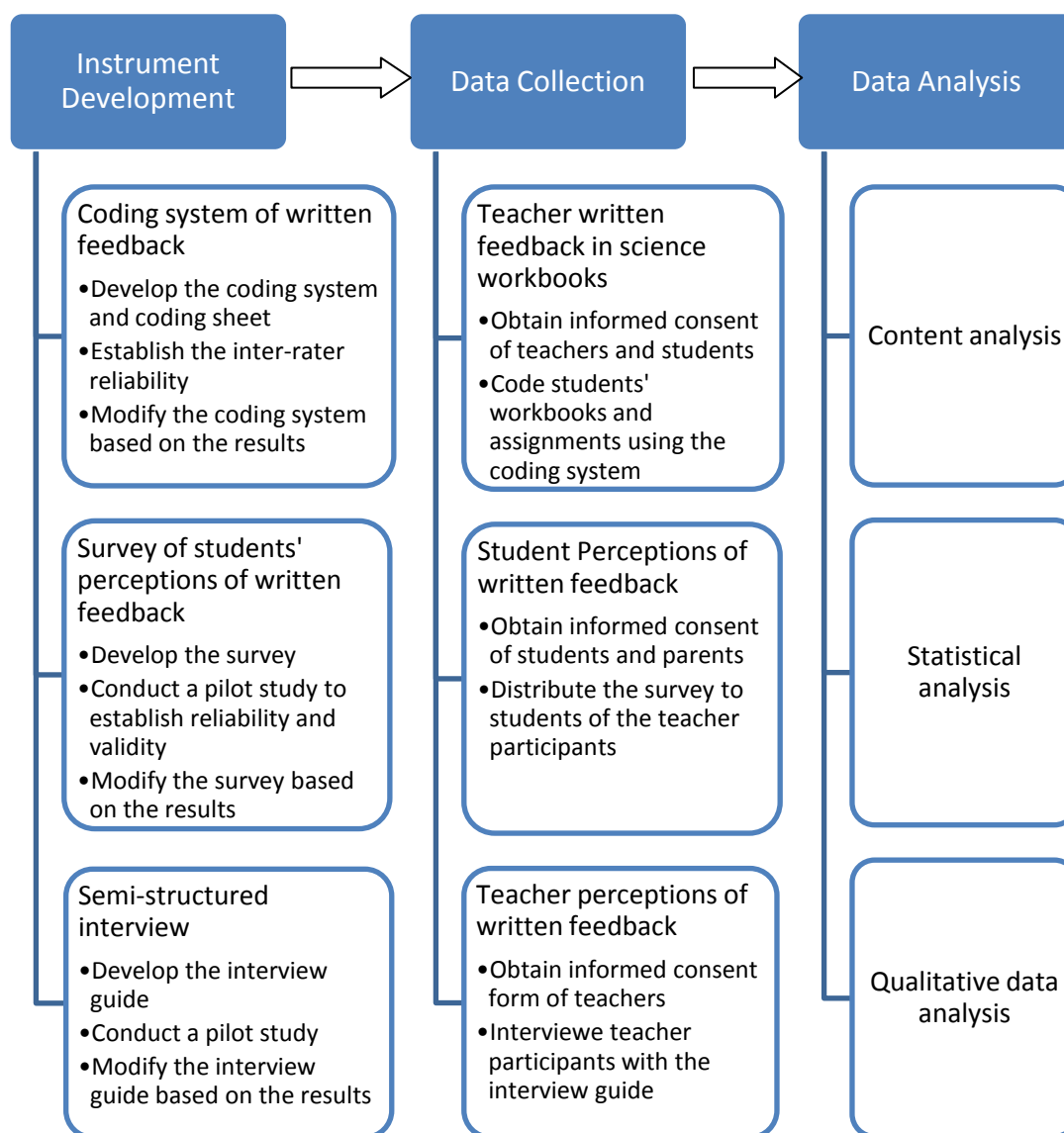


Figure 1. Procedures of this study.

Instrument development. The stage of Instrument Development includes the development of the coding system of written feedback, the survey of student and teacher perceptions of written feedback, and the interview guide for teacher feedback perspectives and practices.

Data collection. The stage of Data Collection includes the obtainment of participants' informed consent, coding students' workbooks and assignments, distributing the survey to students of the teachers, and interviewing teachers about written feedback.

Data analysis. The stage of Data Analysis includes content analysis of teacher written feedback in students' workbooks, statistical analysis of survey data from students and teachers, and qualitative data analysis from teacher interviews.

Instrument Development and Data Collection

Coding system. To evaluate the nature of written feedback provided by science teachers, copies of the marked workbooks were examined and each of the teachers' individual written feedback were classified (cited from Brown, Gibbs, & Glover, 2003; Table 2). Each student workbook and assignment was analyzed on the categories of the written feedback. When an entry of written feedback could not be categorized, the researcher modified the coding system in order to capture the nature of science written feedback. In addition to classifying the written feedback, the overall grade awarded for the work by the teacher, if any, was also noted.

Each entry for written feedback was coded using the approach described. To assess the consistency among the coders, the inter-rater reliability between two coders was estimated. After a score of .9 in reliability reached, the two coders continued to code the rest of the written feedback in student workbooks independently.

Table 2. Classification examples of written feedback.

Feedback Categories	Examples
Identifying errors	Underlined or circled words; 'X'; '?'; 'No'
Giving praise	Ticks; Symbols; 'Good'; 'Excellent'
Correcting errors	Corrected grammar, spellings, dates or individual numerical data
Explaining misunderstandings	'This data is out of date. Recent data shows ...'; 'Don't forget ... which suggests ...'; 'Using ... Shows ...'
Demonstrating correct practice	Underlined or crossed-out sentences or phrases together with a replacement version as a marginal comment; crossed-out whole paragraphs, tables or diagrams with a suggested alternative structures for these as a marginal comment
Engaging students in thinking	'Why?'; 'Is this logical?'; 'Does this follow?'; 'Is this relevant?'; 'Meaning?'; 'Is there an alternative?'
Suggesting further study	'See ... for more information'; 'Information on ... is absent'
Justifying marks	'This assignment was given Grade point 4 because ...'; 'I could not award a higher mark because ...'; 'A higher mark would have been awarded if ...'
Suggesting approaches to future assignments	'In future work you should ...'; 'Next time I recommend ...'; 'Make sure that ... when you submit your next assignment'

Notes: This classification system is based on Brown, Gibbs, and Glover (2003).

A survey of students' perceptions of teacher feedback. To achieve the research goals, a survey of students' perceptions of teacher feedback was developed and analyzed for its quality in reliability

and validity. The survey was designed based on a socio-cultural perspective of feedback (Brookhart, 2004). Table 3 presents the subscales used to measure students' perceptions of different aspects of teacher feedback and classroom assessments.

Table 3. Subscales and examples of the students' perceptions of teacher feedback survey.

Aspect	Examples
A) Curriculum and assessments used in classrooms	<p>How often do you receive science tests/quizzes?</p> <p>How often does your teacher use written assessments provided by the curriculum?</p>
B) Feedback and assessment practices for student understanding	<p>How often does your teacher provide written feedback on your workbook or assignments?</p> <p>What kinds of written feedback does your teacher provide on your workbook or assignments?</p> <p>How often does your teacher use written feedback to inform your learning?</p> <p>How often does your teacher use oral feedback to inform your learning?</p>
C) Attitudes toward feedback and assessment	<p>How much do you agree the following statement: e.g., "The written comments my teachers provide to me do a lot to improve my understanding"?</p> <p>What kinds of written feedback do you like most? Why?</p> <p>What kinds of written feedback do you like least? Why?</p>
D) Goals	<p>Does your teacher set up the same goals for all students?</p> <p>Outside of academic goals, list the goals your teacher have for the students?</p>

The survey also included a background section asking general background information including gender and age. At the end of the survey, open-ended questions were asked in order to collect in-depth information from each student regarding their perceptions of feedback and assessment practices they received. After the survey was designed, a pilot test was conducted to check the reliability and validity of the survey, including item analysis, expert review, internal consistency and factor analysis. Based on the results of analyses, items were modified and then were distributed to students participating in this feedback study.

A semi-structured interview guide. The interviews were carried out in order to investigate science teachers' intentions for the written feedback they provided. The interview started with a

background section asking general background information (e.g., gender, age), teacher preparation and education (e.g., undergraduate and graduate education), and teaching background information (e.g., number of years in teaching, subject(s) and grade level(s) taught).

The teacher interviews primarily included: (1) the factors influencing the writing of their feedback, (2) their intentions and principles in writing the feedback and how these corresponded to what they actually wrote, (3) their perceptions and interpretation of the meaning of the feedback, (4) how the feedback helped their teaching and their students' learning in general, (5) the policy and requirements of assessment practices in the school and how it influences their feedback practices, and the most importantly, (6) the role of gender in the previous five aspects asked in the teacher interviews.

Data Analysis

Content analysis on students' workbooks and assignments. The coding system for written feedback used in this study was derived from Brown, Gibbs, and Glover (2003). The feedback on each piece of marked workbooks was analyzed by classifying each entry of written feedback into one of the study categories.

Statistical analysis on students' and teachers' survey data. The first step of the analysis was to eliminate the invalid surveys with a low percentage in the number of items answered and/or inconsistency on positively and negatively worded items. After the invalid survey data were deleted, descriptive and inferential statistical analyses were conducted, comparing male and female students' perceptions toward science written feedback.

Qualitative data analysis on teacher interviews. As the first step of the analysis, the audio-recorded interviews were transcribed. The transcribed data were then further analyzed. Units of relevant meaning were identified within each interview and clustered to identify general and unique themes.

Results and Discussion

Teachers' Assessment Practices and Perspectives

The means and standard deviations of teachers' assessment practices were presented in Table 4. The highest score was 4.513 for the item of "Use of Personal Comments in Commenting on Student Work", while the lowest score was 3.275 for the item of "Usefulness of Assessment." Compared with teachers' attitudes toward usefulness of assessment, teachers' attitudes toward usefulness of written comments to help student learn were higher with a score of 3.987 (and a smaller standard deviation of 0.348).

Table 4. Descriptive Statistics on Teachers' Assessment Practices

Assessment Practice	Item Content	Mean	Standard Deviation
Use of assessment	Write your own tests, quizzes; revise based on examining work	3.456	0.631
Providing feedback to students	On tests, quizzes, homework, individual work	4.513	0.934
Use of personal comments in commenting on student work	On tests, quizzes, homework, individual work, group work	4.320	0.658
Considerations in assessing student work	Student previous work, background, effort, attitude	3.691	0.442
Usefulness of assessment	Correct mistakes; motivate students; provide positive feedback; inform me regarding progress; compare students to standards	3.274	0.378
Usefulness of written comments	To help improve student performance; students use comments to improve; positive comments are important; comments raise the quality of student work	3.987	0.348

Gender Differences in Teachers' Written Feedback

Independent-samples t tests were used to examine the gender differences of teachers' written feedback practices. The results were presented in Table 5. Teachers' written feedback practices were found significantly different in most of the practices between genders, where the female teacher provided more check marks and grades and less symbols/stamps and written comments than the male teacher. However, the results need to be further confirmed with data from more teachers.

Table 5. Results of the t-tests in gender differences in teachers' written feedback practices

	t value	Sig. (two-tailed)	Mean of Difference	Standard Error
How often does your teacher provide check marks when he/she grades your work?	1.829	.081	.371	.203
How often does your teacher provide grades when he/she grades your work?	3.399	.004	1.143	.336
How often does your teacher provide percentage scores when he/she grades your work?	.474	.640	.154	.325
How often does your teacher provide symbols or stamps when he/she grades your work?	-4.007	.001	-1.500	.374

How often does your teacher provide written comments when he/she grades your work?	-4.488	.000	-1.352	.301
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Gender Differences in Students' Perceptions on Written Feedback

The means and standard deviations of students' perceptions on written feedback were presented in Table 6. Students' perceptions on teacher written feedback were not found significantly different in all practices between genders. However, female students tended to think it is more helpful when their teachers provided marks and/or correct answers when they found an error on the work. Male students tended to think it is more helpful when their teachers provided explanations on an error of the work. However, the results need to be further confirmed with data from more students.

Table 6. Results of the t-tests in gender differences in students' perceptions on written feedback

	t value	Sig. (two-tailed)	Mean of Difference	Standard Error
How helpful do you think when your teacher provides marks on the whole item when he/she finds an error on your work?	-1.234	.227	-.475	.385
How helpful do you think when your teacher provides correct answers when he/she finds an error on your work?	-1.443	.162	-.571	.396
How helpful do you think when your teacher provides marks on an error when he/she finds one on your work?	-.725	.475	-.232	.320
How helpful do you think when your teacher provides marks on the critical part of an item on your work?	.119	.906	.033	.279
How helpful do you think when your teacher provides explanation on an error when he/she finds one on your work?	.442	.662	.133	.301
How helpful do you think when your teacher provides explanation on the whole item on your work?	.190	.850	.058	.303
How helpful do you think when your teacher asks you correct an error on your work?	-.152	.880	-.052	.345

The results demonstrate that science teachers in this study perceived assessment of written comments was more helpful for student learning than assessment in general. Furthermore, female teacher was found to provide more check marks and grades and less symbols/stamps and written comments than male teacher. In terms of students' perceptions on written feedback, female students tended to think it is more helpful when their teachers provided marks and/or correct answers when they found an error on the work and male students tended to think it is more helpful when their teachers provided explanations on an error of the work. However, the results need to be further confirmed with data from more students.

Assessment and feedback perceptions and practices of teachers differ in genders in this study. The results suggest that understanding of what it means to teach and assess is tied to teacher's gender or culture. Items most strongly associated with the domains assessed in the survey helped explain differences that might exist across genders. The results also suggest that beginning teachers need to be aware of the effect of gender on how to develop and use classroom assessments to improve student learning. It is further suggested to develop this study by first, exploring possible reasons why male and female teachers differ in feedback perceptions and practices. Second, more teachers and students are needed for investigating other differences and similarities. The results can help teacher education programs prepare teachers to assess students' work and give feedback and building in opportunities for more experienced mentor teachers to provide support and feedback to beginning teachers to help them develop student assessment skills in different genders.

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106年度專題研究計畫成果彙整表

計畫主持人：蔡欣珮		計畫編號：106-2629-H-152-001-MY2		
計畫名稱：國小科學教師書面回饋之性別差異：學生知覺、教師觀點與教師實踐之研究				
成果項目		量化	單位	質化 (說明：各成果項目請附佐證資料或細項說明，如期刊名稱、年份、卷期、起訖頁數、證號...等)
國內	學術性論文	期刊論文	0	篇
		研討會論文	0	
		專書	0	本
		專書論文	0	章
		技術報告	0	篇
		其他	0	篇
國外	學術性論文	期刊論文	0	篇
		研討會論文	0	
		專書	0	本
		專書論文	0	章
		技術報告	0	篇
		其他	0	篇
參與計畫人力	本國籍	大專生	0	人次
		碩士生	3	
		博士生	0	
		博士級研究人員	0	
		專任人員	0	
	非本國籍	大專生	0	
		碩士生	0	
		博士生	0	
		博士級研究人員	0	
		專任人員	0	
其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)				