Aprendí también lo que es una fotocopia, pero qué pena que no entendí muy bien su proceso. Otra cosa legal es saber cuando un cuerpo está electrizado positivamente y negativamente. Positivamente es cuando el número de electrones es menor que el número de protones, y negativamente cuando el número de electrones es mayor que el de protones. Otra cosa interesante que aprendí fue como es hecho un imán, él es hecho de mineral de hierro, y ellos se atraen cuando los polos son contrarios y se rechazan (se alejan) cuando los polos son iguales. ...Me pareció interesante también saber de verdad lo que es un rayo, rayo es una descarga de electrones de una nube para otra, o sea, es como... por ejemplo, tú estás triste y yo feliz de la vida, entonces descargo toda o un poco de mi alegría en ti, ¿entendiste? Otra cosa que aprendí, que me llamó la atención es que yo siempre oía hablar de electroscopio, pero nunca podía saber lo que era, en ese proyecto aprendí. Electroscopio es todo aparato capaz de detectar si un cuerpo está o no electrizado. Bien, ahora hablando de mí, estoy bien saliendo mucho y divirtiéndome aún más. Pero la verdadera razón por la que te escribo es para comunicarte que el día 29 en el Piritubão habrá un show de reggae y estoy contando con tu presencia. Escríbeme estoy muriendo de nostalgia 1000 besos, Daiane.	es el siguiente: cuando el eje gira, el imán también gira (como ya te expliqué) y ese movimiento "produce" electricidad en la bobina, y, finalmente la bobina está conectada a cables, que tú puedes conectar a una lámpara por ejemplo Los aparatos eléctricos tienen motores que "transforman" la energía eléctrica en movimiento, o calor, o frío, etc. Por ejemplo el horno de microondas "transforma" energía eléctrica en calor, ¿entendiste? ¡Ah!, una cosa interesante que yo aprendí fue cómo funciona una hidroeléctrica: en ella se acumula una gran reserva de agua. En la parte de abajo de la pared, ellos colocan tubos, para que el agua salga con más presión. Esa agua hace girar un gran imán, y éste está envuelto por una bobina, y como ya te dije anteriormente, la bobina "produce" electricidad. Esa energía generada en la bobina "pasa" por unos cables que por fin es distribuida para mí y para tu casa. Bien, aprendí sobre los motores eléctricos: en la licuadora, por ejemplo, el cable que tu enchufas "le da" electricidad a una bobina – la bobina con electricidad es como un imán. Entonces hay también un imán dentro de la bobina, y ya que los polos diferentes se atraen, y los iguales se rechazan, hay un giro de ese imán. Finalmente, el imán está unido a un rotor, que gira junto con el imán. Por fin, supe de la dificultad para inventar una bombilla eléctrica hasta que Thomas Edison llegó a una ampolleta con un filamento de carbón a alto vacío dentro de la ampolleta. Con el tiempo la lámpara sufrió varias reparaciones hasta llegar a lo que ella es hoy día. Espero que hayas comprendido. Un gran abrazo, Thyago.

MATERIAL MEC- Tiago Felipe.	MATERIAL BA - Geison
Para Denis. Yo aprendí varias cosas sobre electricidad. Cuando el cuerpo está electrizado positivamente o negativamente, lo que sucede es que las cargas se atraen o se rechazan. Un cuerpo está electrizado positivamente cuando posee menos electrones que protones, y negativamente, cuando el número de electrones es mayor que el de protones. Ahora te voy a contar cómo las cargas eléctricas se atraen y se rechazan. Las que se atraen son aquellas que tienen signos contrarios y las que se rechazan son las que tienen los mismos signos. Yo estoy seguro que tú no sabes lo que es una copia xerográfica... Es una imagen que se origina por iluminación en un cilindro revestido por selenio, que antes el fue cargado con energía positiva. Este cilindro tiene [que copiar] apenas la región iluminada. La iluminación, cuando alcanza el papel, ahí aparecen las letras. Te voy a contar otra cosa que tú no sabías. El imán, nadie sabía que es hecho de hierro (magnetismo) y también que los polos del imán que se atraen tienen que ser iguales. Los contrarios se rechazan. Para terminar, para que tú economices energía en tu casa, usa bombillas fluorescentes. Tiago Felipe.	Querido amigo Douglas. Te mando esta carta para contarte lo que aprendí sobre electricidad. ¿Tú ya oíste hablar de dínamos? Es el mismo aparato que algunas bicicletas usan para encender las linternas. Bueno, él funciona más o menos así: el dínamo está conectado a la rueda y así, cuando las ruedas están en movimiento, haciendo con que un imán, dentro del dínamo se mueva. Por fuera del imán hay un alambre de cobre y en ese alambre está conectada la linterna. De la misma manera que el movimiento del imán genera electricidad, la electricidad puede producir movimiento. Sólo que el proceso es al contrario, la energía es enviada para el alambre de cobre de la bobina, produciendo el movimiento del imán y es de esa forma que algunos aparatos eléctricos funcionan, como la licuadora. Yo aprendí también que la represa, que tiene un hoyo dejando caer el agua, abajo del agua hay una bobina que está conectada a un motor semejante a un dínamo. Viste cuántas cosas estoy aprendiendo por aquí. Yo estoy pensando en hacer un dínamo usando un motor de licuadora... *De tu amigo,* Geison.

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Science electronic portfolios: developing and validating the scoring rubric

Desarrollando y validando los portafolios electrónicos en la enseñanza de las ciencias

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Abstract

Research has indicated a great need to evaluate the experiences related to creating an electronic portfolio to contribute to the overall teaching excellence. Instructors use rubrics to evaluate electronic portfolios, but no study has been conducted to examine whether the rubrics are valid to measure students' learning. This study described the process of developing an electronic portfolio rubric, and examined its validity and reliability to assess preservice science teachers' performance. Electronic portfolios of 59 preservice teachers from a Midwestern University were included in the analysis. A rubric was developed by the authors to assess the electronic portfolios. The data analysis indicated a reliability of (r= .756) for the rubric. Item analysis was also conducted to examine the construct validity of the rubric. The major results indicated that rubric can be a pragmatic vehicle to evaluate electronic portfolios.

Key words: electronic portfolio, evaluation, science education.

Resumen

La investigación ha demostrado una gran necesidad de valorar las experiencias relacionadas con crear un portafolio electrónico para contribuir a la excelencia de la *enseñanza. Los instructores usan rúbricas para valorar portafolios electrónicos, pero ningún estudio ha sido dirigido para revisar si las rúbricas son legítimas para medir el aprendizaje de los estudiantes. Este estudio describió el proceso para desarrollar una rúbrica de portafolios electrónica, y revisó su validez y confiabilidad para evaluar el rendimiento de los estudiantes de licenciaturas en ciencias. Portafolios electrónicos de 59 estudiantes de licenciaturas de Midwestern University fueron incluidos en el análisis. Una rúbrica fue elaborada por los autores para evaluar las carteras electrónicas. El análisis de datos demostró una confiabilidad de r = .756) para la rúbrica. El análisis también era dirigido para revisar la validez de la rúbrica. Los resultados indicaron que la rúbrica puede ser una herramienta pragmática para valorar los portafolios electrónicos.*

Palabras clave: portafolios electrónicos, evaluación, educación en ciencias.

INTRODUCTION

Recently, the performance-based assessment and curricula have increasingly been emphasized in schools. The national standards of technology, as well as, science and other various subjects provided accountability measures to such emphasis. Teacher education programs need to be responsive to the direction of performance education (NTASC). In using new technologies for the portfolio, the assumption seems to be that we can substitute one medium for another-keeping the benefits of traditional print formats while adding a host of new conveniences. The past experiences with innovative technologies would suggest one technology cannot be so easily swapped for another. The introduction of a new tool into human activity often changes that activity in ways unanticipated and sometimes profound (Author, 2003; Barrett, 2003). Wiedmer (1998) indicated that the reported benefits of the electronic portfolio development process are similar to those that have recorded for developing the hard-copy portfolio, but the enhanced medium offers additional ways for developers to display unique talents and abilities. The rapid movement toward all forms of web-based communication makes it likely that, in the future, this particular electronic medium will play an important role in the communication of teacher knowledge. However, we know very little about the implications of using the web for portfolios.

It has been reported that electronic portfolios, as performance assessment, differ from the traditional assessment in that they are broader in scope and more authentic (Barrett, 2000; Campbell, Melenyzer, Nettles, & Wyman, 2000). Barrett (2003) suggested that the use of electronic portfolios helps incorporate technology into K-12's learning and allow students to share their work with peers. However, she added that a portfolio without standards is just a multimedia presentation or a fancy resume or a digital scrapbook. There is a great need to address whether the experience of creating an electronic portfolio contributes to the development of reflection and overall teaching excellence and, if so, how this improvement occurs. Research has indicated many purposes for portfolios, which can be for learning, assessment, and employment. Electronic portfolios are robust (Barrett, 2000; Bhattacharya, 2001; LaBoskey, 1994; Wineburg, 1997). The flexibility of the web, video streams, animations, Flash, Splash, and other programs provide the portfolio developer with multiple tools to present her/his artifacts and reflections. There is a lack of research on developing a valid and reliable rubric to measure students' experiences with portfolios.

The purpose of this study were (1) to describe the process of developing an electronic portfolio rubric, and (2) to examine its validity and reliability to assess preservice science teachers' performance. The assumption is that if electronic portfolios were to be used with teacher education graduates, they need to be successful in accomplishing their goals, worth the time spent in creating them, and advancing learning.

METHODOLOGY

Participants

Participants were 59 preservice teachers at a Midwestern University who were enrolled in elementary and secondary science methods courses. All students were juniors and seniors in the last stages of their teacher education programs. Among the 59 participants, 12 students were male and 47 students were female, 41 students majored in elementary education, and 18 majored in secondary education. The instructor obtained students' consent at the beginning of the courses to allow for using classroom data for research purpose. As part of these courses' requirements, students were required to build a web-based electronic portfolio incorporating reflective narratives of the best artifacts that illustrate their learning experiences. Artifacts/assignments included in the e-portfolio expand from various experiences related to the course. The electronic portfolio included artifacts such as biography, in-class activities, inquiry lesson file, peer teaching and field experience journals, educational philosophy, summary reports, and reflective narratives.

Science Methods Courses

The science methods courses had two main goals for incorporating the electronic portfolio: 1) to improve students learning of science concepts covered in the course; and 2) to assess students' ability of using technology. The authors developed a scoring rubric to be used in assessing students' learning and technology mastery in building the electronic portfolio. Participating preservice teachers were instructed, in two lab sessions, of how to build a web-based portfolio, what requirements does it include, and how to write reflections. Some of the preservice teachers had experiences creating Web pages using Netscape Composer and FrontPage Netscape's Composer, FrontPage, HomePage, etc. Scalability is managed with the web-editing programs, such as those mentioned, which make it possible for a browser to open files and navigate the portfolio with relative ease regardless of the development platform used. Each student had an account with enough memory space on the university's server to accommodate the portfolio and other projects. The training session included saving and giving names to files; choosing color scheme and background color; choosing an image; adding text, graphic, or table; linking pages. Other electronic options were Windows NT environment, HTML, other software program that is web-based.

Electronic Portfolio Rubric

An electronic rubric was developed by the authors to be used to monitor student performance. Three experts in the electronic portfolio field indicated its soundness. A major purpose of this study was to examine the electronic rubric validity and reliability. The electronic rubric contains eight items measuring course requirement in the areas of science. The data analysis was based on the obtained scores in the rubric. The portfolio rubric included eight items relate to developing appropriate content and technology for the electronic portfolios (Author, 2003; Farr & Tone, 1994). These items were selection of appropriate artifacts, adequacy of reflection writing, alignment of appropriate standards, use of effective technology, and use of the appropriate format, software, mechanics, and language. In the rubric, a -4 point Likert scale was used for item 1-7, and the total maximum score a student can get is 30 points. Data were collected from each item as well as the overall score of the electronic portfolio for each participating preservice teacher.

Data Analysis

The data analysis was based on the obtained participating preservice teachers' electronic rubric scores. Descriptive statistics, t-test, and item analysis were conducted to examine the item composition and internal reliability of the electronic rubric as an assessment tool. Data analysis was undertaken using SPSS 11.5 for windows.

RESULTS

The average item score ranged from 3.88 to 3.27. The total point average was 26.71. According to the total accumulated scores for each item, the instructor also gave each student a letter rating that corresponding to the total obtain numeric score they obtained in the rubric. Among the 59 students, 23 were rated as outstanding, 29 were satisfactory, 5 needed improvement, and 2 students received unacceptable letter grade.

Group comparison was conducted using independent sampled t-tests to determine if there was a significant difference in average of the obtained 7 item score between male and female students. Elementary major students were also compared with secondary students for the same score. For calculation purpose, the average of the 7 item scores were added together as dependent variable, gender (male, female), and grade (elementary, secondary) were used as independent variables in the sampled t-test. The statistical results indicated that there were no significant difference between male and female, between elementary and secondary students in average the 7 item score. Table 1 presented the t-test outcome and the mean difference between groups.

Table 1
Group comparison between gender, grade level and average obtained scores

Gender	N	Mean	t	Sig. (2-tailed)	M Difference
Item Mean Male	12	3.74	1.46	.150	.239
Female	47	3.50			
Grade Elementary	41	3.52	-.572	.569	-.083
Item Mean Secondary	18	3.61			

Item Analyses and Internal Reliability

One of the basic criteria for the content validity of an instrument is, "at least a moderate level of internal consistency should exist among the items; i.e., the items should tend to measure something in common" (NUNNALLY, & BERNSTEIN, 1994, p103). In order to examine the internal consistency of each items, and the overall internal consistency of the rubric, item analysis was conducted to determine the contribution of each item to the composite score and coefficient alpha. Item analyses indicated that each of the 7 items had positive contribution to composite score. No negative contribution was found among the 7 items for the composite score of the electronic rubric. The reliability coefficient alpha was .756, indicating the instrument was internally consistent. Table 2 presents the internal consistency information from item analysis.

Table 2
Internal Consistency Reliability of Items for the Electronic Rubric

Reliability Statistics		Item Name		Total Point					
	Item1	Item2	Item3	Item4	Item5	Item6	Item7		
Maximum score	4	4	4	4	4	4	4	30	
Item mean	3.48	3.39	3.32	3.57	3.64	3.90	3.79	27.00	
Variance if item deleted	27.71	28.77	28.38	27.24	28.32	31.75	29.66	8.72	
I Discrimination	.735	.688	.571	.780	.780	.400	.627	.883	
Alpha	.710	.723	.724	.704	.716	.756	.733	.853	.756

DISCUSSION

In the present study, there were more female and elementary major students than male and secondary major students. This probably represented the population composition in college of education across the country. When we examined further if there was significant difference between gender and major in obtained scores in the rubric, independent t-test results did not indicate statistical difference. However, we did find that male students scored higher than female students by .239 points in average, secondary major students score higher than elementary major students by less than 1 (.083) point in average.

The outcome of item analysis of the rubric indicated that each of the 7 items and the total point score contributed positively to the composite score of the total rubric as a measurement. The item discrimination index ranged from .883 to .400. This suggested that each item individually contributed moderately too highly to discriminate student's performance and the total rubric score. Each item played a positive role to the measurement as a whole. The reliability coefficient alpha of the rubric was .756. It was concluded that the instrument is internally consistent and reliable in measuring the content the instructor designed to measure.

As presented in Table 1, the t-test outcomes indicated that male students scored higher than female students by .239 points in average. Secondary major students scored higher than elementary major students by .083 points in average. However the differences between male and female, between secondary and elementary students were not statistically difference at .01 or .05 levels. These results showed that participants in this study did not perform differently because of their gender or program. These results also suggested that the electronic portfolio rubric was measuring science performed equally well for preservice teachers of both genders across different program areas.

As presented in Table 2, the item analysis did not indicate a negative contribution with the 7 items for the composite score of the electronic portfolio rubric. The reliability coefficient alpha was .756 indicating that the instrument was internally consistent, thus reliable. At least a moderate consistency is required for an instrument to have a content validity (NUNNALLY & BERNSTEAIN, 1994). These results gave a preliminary assurance that the electronic portfolio rubric, in this study, measured what was intended to measure- participants' science learning experiences. The rubric items included learning aspects such as: developing electronic portfolio, selecting appropriate assignments and artifacts, demonstrating adequacy of reflections, using and incorporating of related standards, and using appropriate technology and format. These aspects set the desired portfolio objectives which are guided similar research (FARR & TONE, 1994). These results were of important for the purpose of the study which was examining the reliability and validity of the electronic portfolio rubric used.

Preservice teachers can learn a lot about technology as they use technology in order to accomplish other worthwhile educational tasks. As such, there are several benefits identified in this study that are related to science teachers creating electronic portfolios. Some of the benefits were the use and mastery of technology skills, adequacy of reflection writings, and aligning standards to learning experiences. The scoring rubric in this study measures participants' skills of the use of appropriate computer application and its features. Majority of participating preservice science teachers (88.1%) were able to have an outstanding or satisfactory overall rate on the electronic portfolio. Only small number of participants (8.5%) had overall rating of needs improvement. A very small number of participants (3.4%) had unacceptable rating of their electronic portfolio. This result is, in general, similar to other portfolio rubric findings with regard to the passing rate of outstanding and satisfactory rates (BARRETT, 2001; MCKINNEY, 1998).

CONCLUSIONS

The literature review showed a great need for addressing whether the experience of creating an electronic portfolio contributes to the development of reflection and teaching. Participants of this study developed understanding of learned materials and technology use through their portfolio's reflective narratives. They were able to show a progress in their learning and readiness to become teachers. Other students exhibited a change of conception and belief from their earlier philosophy statement and way of teaching science. Some other students went further to admit that science should not be taught other than an inquiry process. The analysis of the preservice reflective narratives indicated a deeper understanding of students learning as well as the course instruction. Overall, the use of the electronic portfolio allowed preservice teachers to better understand the science materials covered in the course and increased their knowledge of the use of technology. In the present study it was evident how students' learning was improved due to reflecting on it at the portfolio's stage. The use of electronic portfolio and the reflections should be further examined to unfold its benefit in science education and teacher education programs. There are few studies found related to the development of portfolio rubrics. This study provided valuable results on this regard. Further analysis should be done to this portfolio rubric to be used with similar programs.

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