PROFESSIONAL DEVELOPMENT PROGRAM ON INNOVATIVE TEACHING STRATEGIES FOR NOVICE SCIENCE TEACHERS

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Abstract.

This study aimed to provide professional development to novice teachers for modifying science teaching strategies innovatively. The program involved 15 primary teachers with diverse genders, ages, educational backgrounds, and teaching experience. The program was developed through a four-stage training model: reflection, identification, analysis, and modification. The study assessed participants' understanding of innovative science teaching through a pre-test, post-test, journals, worksheets, and lesson plans with data analyzed descriptively and qualitatively. Results showed that most teachers (73.3%) could participate in the training stages optimally, which increased their competence in modifying innovative science teaching strategies. However, some teachers needed help during the training process, which was influenced by factors such as educational background and teaching experience. The study found that a teacher's educational background and teaching experience positively influence their competence, with better alignment and more experience enhancing pedagogical skills. A training program fostered lifelong learning, motivating teachers to create development plans. Then, teachers also formed learning communities through social media, enhancing their collaboration and professional growth.

Keywords: professional development program; innovative teaching strategies; novice science teachers

PROGRAM PENGEMBANGAN PROFESIONAL PADA STRATEGI PENGAJARAN INOVATIF UNTUK GURU SAINS PEMULA

Abstrak. Penelitian ini bertujuan untuk mengembangkan profesionalisme guru pemula dalam memodifikasi strategi pengajaran ilmu pengetahuan alam (IPA) secara inovatif. Program ini melibatkan 15 guru sekolah dasar dengan latar belakang gender, usia, pendidikan, dan pengalaman mengajar yang berbeda. Program ini dikembangkan melalui model pelatihan yang terdiri dari empat tahap: refleksi, identifikasi, analisis, dan modifikasi. Penelitian ini menilai pemahaman guru tentang pengajaran IPA inovatif melalui pre-test, post-test, jurnal, lembar kerja, dan rencana pelaksanaan pembelajaran, kemudian data yang diperoleh dianalisis secara deskriptif kualitatif. Hasil menunjukkan bahwa sebagian besar guru (73,3%) dapat mengikuti tahapan pelatihan secara optimal, sehingga meningkatkan kompetensi mereka dalam memodifikasi strategi pengajaran IPA inovatif. Namun, beberapa guru mengalami kesulitan selama proses pelatihan, hal ini dipengaruhi oleh beberapa faktor seperti latar belakang pendidikan dan pengalaman mengajar. Penelitian ini menemukan bahwa latar belakang pendidikan dan pengalaman mengajar seorang guru berpengaruh positif terhadap kompetensinya, keselarasan yang lebih baik dan pengalaman yang lebih banyak meningkatkan keterampilan pedagogis. Program pelatihan ini juga mendorong pembelajaran sepanjang hayat, memotivasi guru untuk membuat rencana pengembangan. Kemudian, para guru juga membentuk komunitas belajar melalui media social yang meningkatkan kolaborasi dan pertumbuhan professional mereka.

Kata Kunci: program pengembangan profesional; strategi pengajaran inovatif; guru IPA pemula

I. INTRODUCTION

In the learning process, the success of teaching depends on various interrelated components, including the teacher's role as an educator (Kennedy, 2016; Sancar *et al*., 2021; Bragg *et al*., 2021; Zulela *et al*., 2022). The teacher is not merely a transmitter of knowledge but a facilitator who guides, motivates, and supports students' development. Effective teaching requires a combination of subject expertise, pedagogical skills, and the ability to foster a positive learning environment. The teacher's capacity to adapt to students' diverse needs, learning styles, and socio-emotional contexts plays a crucial role in achieving educational outcomes.

Additionally, the teaching plan is a critical component of the learning process. It serves as a roadmap that outlines the objectives, content, methodologies, and assessment strategies necessary to achieve the desired learning outcomes (Kusumaningrum *et al*., 2019; König *et al*., 2020; Murkatik *et al*., 2020; Herwin *et al*., 2021). A well-structured teaching plan provides clarity and coherence, ensuring that instructional activities are purposeful and aligned with the learning goals. It also enables teachers to employ appropriate teaching strategies, such as active learning, collaborative work, or differentiated instruction, to meet the needs of all learners.

Teaching strategies refer to the planning that is carried out to organize interactive activities between students, educators, and media resources to achieve the educational objectives that have been set (Pambudi & Gunawan, 2020; Rapanta *et al*., 2020; Rasmitadila *et al*., 2020). In order to deliver effective learning, teachers need suitable strategies to

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support the learning process (Caena & Redecker, 2019; Komalasari *et al*.; Oke & Fernandes, 2020; Lapitan *et al*., 2021). Teaching strategies play a crucial role in creating effective learning environments that make students more interested (Fauth *et al*., 2019; Howard *et al*., 2021; Yurtseven Avci *et al*., 2020; Wardani *et al*., 2023). The strategy and method of teaching are components of the learning system that cannot be separated from other factors such as learning objectives, teaching materials, students, facilities, time, and teachers (Konopka *et al*., 2015; Irmayani *et al*., 2018; Suryawati & Osman, 2018; Alenezi, 2020).

Preliminary observations of several primary school teachers in Cilegon City indicate that they are still considered novice teachers in developing teaching strategies, particularly in science education. This challenge arises due to limited experience and insufficient access to training that promotes the use of innovative teaching strategies. Therefore, a structured effort is needed to enhance teachers' competence in designing and implementing creative and effective science teaching strategies. One solution is to implement a comprehensive professional development program. This program includes intensive training, ongoing support, and mentoring specifically designed for teachers in Cilegon City.

This study presents a distinct four-stage professional development model—reflection, identification, analysis, and modification. Unlike conventional training, it emphasizes active teacher engagement through self-reflection, collaboration, and learning communities via social media. Additionally, the study investigates the impact of each teacher's background on their ability to modify science teaching strategies, which constitutes the novelty of this research.

This study is significant for science education as it offers a practical framework to enhance novice teachers' pedagogical skills. By adopting more innovative science teaching strategies, teachers can deliver engaging and meaningful learning experiences that promote student engagement and foster critical and creative thinking. Furthermore, the program cultivates lifelong learning, fostering a collaborative and innovative professional culture in science education.

The research questions in the professional development program of teachers through the training program of modifying science teaching strategies will be: RQ 1: How can teachers improve their competence in modifying science teaching strategies after implementing the training program?; RQ 2: How do demographic factors (gender, age, educational background, and teaching experience) influence teacher competence in modifying science teaching strategies?

II. RESEARCH METHOD

This study aimed to develop training programs designed to enhance the skills of novice teachers, with a focus on equipping them with effective science teaching strategies. These training materials were adapted versions of established teaching methodologies, modified to align with the unique needs of novice educators. The intention was to provide practical, research-based strategies that beginner teachers could implement to improve their instructional effectiveness and confidence in the classroom.

The study utilized a descriptive qualitative research design, which emphasizes a comprehensive, in-depth exploration of the phenomena being studied. Åkerblad et al. (2021), explain, descriptive qualitative research seeks to holistically understand complex aspects such as behavior, perceptions, motivations, and actions within a particular context. This approach is especially well-suited for educational research because it captures the nuanced experiences of participants, offering rich, detailed insights into their interactions, challenges, and growth throughout the training process.

A. Participant

The training programs had 15 volunteer primary teachers. Demographic information is presented in Table 1.

TABLE 1. Teachers Demographic Information

Variable		N	%
Gender	Male	4	26.7
	Female	11	73.3
Age	20-30 years	6	40.0
	30-40 years	6	40.0
	40-50 years	3	20.0
Education	D2	5	33.3
	S1	10	66.7
Teaching Experiences	< 5 years	4	26.7
	5-10 years	8	53.3
	> 10 years	3	20.0

It is generally known that the teachers who volunteered for the study came from diverse backgrounds in terms of gender, age, educational qualifications, and teaching experience. Most participants were female. In terms of age, the 20-30 and the 30-40 age groups were equally represented. Some participants held diplomas, while others had bachelor's degrees. Interestingly, four participants had non-educational degrees in natural science, engineering, management, and information systems, but they had experience teaching in classrooms. Finally, most participants had between 5 and 10 years of teaching experience.

B. Training Model

The study employed a training model named RIDAM that equips teachers with the necessary skills to modify science teaching strategies. RIDAM stands for Reflection, Identification, Analysis, and Modification. Each stage of the RIDAM model (Figure 1) is described below to provide a better understanding of the model.

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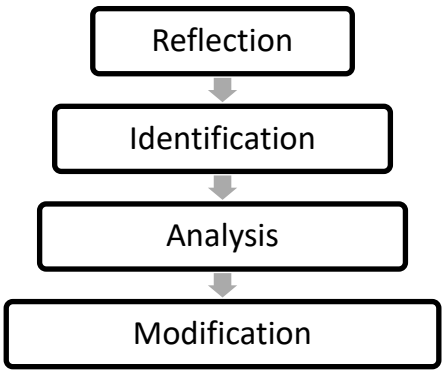

Figure 1. CT Test Format

In the first stage, participants must reflect on their knowledge and experience related to science teaching strategies. They need to fill out a reflection journal and outline the advantages and weaknesses of science teaching strategies they have already mastered or used. This should be done as a list of the reflection results. The second stage involves participants identifying lesson plans based on compatibility with teaching strategies, learning objectives, learning materials, and student characteristics. The results of this identification are then discussed and presented. The third stage involved participants searching for and analyzing recent literature on innovative science teaching strategies, which they used to determine ideas for modification. The participants in the fourth stage drafted innovative teaching strategies, modified them, designed lesson plans, and presented the outcomes.

The training program was held at Universitas Bina Bangsa for 15 primary school teachers, split into two meetings and must be completed in the main program. However, it continued in the companion training program for an additional meeting to help support the implementation of the professional development program. This supplementary program aims to help participants understand and apply lifelong learning.

C. Data Collection and Analysis

The study involved collecting data through various methods. Firstly, a pre-test consisted of 15 questions about knowledge of innovative science learning strategies. Then, a post-test containing a case study was conducted to determine how participants could modify existing teaching strategies. A reflection journal was used to gain insights about the knowledge, experiences, and limitations related to science teaching strategies that participants had mastered or used. An identification worksheet was used to determine the participant's ability to identify areas for modification in science learning strategies. An analysis worksheet was used to determine the participants' ability to summarize the results of recent literature analysis related to innovative science teaching strategies. Lastly, lesson plans were used to determine participants' ability to design and implement modified innovative science teaching strategies. The obtained data was analyzed descriptively and qualitatively.

III. RESULTS AND DISCUSSION

A. How can teachers improve their competence in modifying science teaching strategies after implementing the training program?

Before the training, the teachers were requested to complete a reflection journal and a pre-test through the Google Form application. The pre-test contained questions to explore the teachers' knowledge, experience, and limitations in implementing science teaching strategies they had used so far.

Figure 2. Participants' activities during the training program

Based on the results of the reflection conducted by the participants, information was obtained that most participants (>50%) still rarely made innovative modifications to science teaching strategies to be used in the classroom; this is caused by various reasons, including:

a. Participants were worried that the student would not understand the learning content because the teaching process was not optimal or the teaching strategies used were inappropriate.
b. Participants were also worried about the duration of time used if they had to use specific teaching strategies.
c. Participants stated they needed more learning materials, tools, and resources to be applied during the learning process.

Participants have concluded that they require knowledge of innovative science teaching strategies modifications to ensure optimal and effective learning. They also stated that teachers must continue to learn about different teaching strategies to keep the learning process varied, engaging, and fun. After reflecting, they have realized that teachers must be more creative in applying teaching strategies in class to achieve the desired learning objectives.

Only 3 out of 15 participants in the pre-test could answer 70% of the questions correctly. This indicates a need for more knowledge among the participants regarding innovative science teaching strategies. As a result, they are hesitant to apply them in the classroom.

During the identification stage, participants were asked to identify science lesson plans they had prepared based on the suitability of teaching strategies with learning objectives, learning materials, and student characteristics. Results showed that 73.3% of participants could identify limitations or weaknesses in their lesson plans. Through researcher training, they were able to modify their teaching strategies. Participants reviewed three articles on innovative science teaching strategies in the analysis stage. Results

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showed that most participants could summarize the information obtained from the articles. They found information about models, approaches, methods, and techniques that can be applied to innovative science teaching. Participants implemented modified science teaching strategies in their lesson plans in the modification stage. They described indicators based on selected competencies, determined learning objectives, and teaching strategies such as approaches, models, methods, and techniques. After determining the teaching strategies, participants compiled the teaching steps based on the steps in the selected teaching strategies.

The lesson plan results have shown that participants could identify suitable teaching strategies based on learning objectives, materials, and student characteristics. About 70% of the produced lesson plans clearly understood what students will learn, how they will learn it, and what activities they will engage in, using innovative science teaching strategies such as methods, models, techniques, and approaches.

After following the activities based on the developed training model, participants were given a post-test in case study questions related to applying science teaching strategies. The participants were asked to make improvements or modifications to the learning in the case study and to identify the strengths and weaknesses of the teaching strategies. Post-test results indicated that 73.3% of participants could determine the necessary improvements or modifications using innovative science teaching strategies. Additionally, they outlined the strengths and weaknesses of the learning in the case study and provided suggestions to overcome the weaknesses.

B. How do demographic factors (gender, age, educational background, and teaching experience) influence teacher competence in modifying science teaching strategies?

After analyzing the results of the developed training program for novice science teachers, it was found that there was an improvement in their competencies to modify innovative science teaching strategies. However, upon closer examination, it was apparent that some participants still experienced difficulty in this area. According to the program's results, only 73.3% of the participants could properly carry out the identification to modification stages, while 26.7% had less than satisfactory results.

After analyzing the results, the study investigated possible reasons for differences in competency improvement among participants. To gain deeper insights, demographic information of the participants was examined, and the following results were found:

a. The participants who faced difficulties or obstacles in modifying their science teaching strategies came from diverse backgrounds in terms of gender, age, educational background, and teaching experience.
b. The participants who faced difficulties or obstacles in modifying their science teaching strategies comprised two males and two females aged 20-40 years. They also had different educational backgrounds, with one participant having a diploma in education and the other three having bachelor's degrees in non-education fields. Their teaching experience ranged from 1-10 years (one year, two years, seven years, and ten years).

The information presented reveals how the demographics of participants/teachers can impact the training results aimed at improving innovative science teaching strategies. The data shows that out of four were non-education graduates. This suggests that a teacher's educational background can affect their competence, particularly in pedagogical skills (Garzón Artacho *et al*., 2020; Murkatik *et al*., 2020; Cabero-Almenara *et al*., 2022). Further analysis reveals that teaching experience plays a crucial role in the success of the training. Three out of four teachers who faced challenges had less than ten years of experience, while those with over ten years of experience demonstrated significant progress at each training stage. This suggests that more experienced teachers are better able to integrate new, innovative teaching strategies. Their longer experience enables them to handle classroom challenges more effectively and adapt their teaching methods to better meet students' needs.

The correlation between teaching experience and pedagogical competence is evident in how more experienced teachers are better able to adapt to changes and refine their teaching methods. They typically have a deeper understanding of classroom dynamics, management, and adjusting to diverse student learning styles. In contrast, less experienced teachers may struggle to implement new strategies due to their ongoing process of learning and adapting to classroom challenges.

Additionally, a teacher's age also influences their pedagogical competence. The data shows that teachers aged 20 to 40, regardless of gender, faced greater difficulty in modifying their teaching strategies. This age range often represents the early stages of a career, and limited teaching experience can hinder their ability to effectively absorb and apply new concepts. In contrast, more experienced teachers tend to have greater confidence in implementing changes to their teaching approaches.

The findings of this study are consistent with previous research indicating that teacher competence is influenced by several factors, such as educational background, teaching experience, and age. Studies by Sulaiman & Ismail (2020), Rusilowati & Wahyudi (2020), Jacob *et al*., (2020), Lepp *et al*. (2021) and Istiyono *et al*. (2021) demonstrate that pedagogical competence is not isolated but shaped by these factors. For instance, teachers with educational backgrounds closely aligned with the subjects they teach are better able to adopt innovative teaching strategies. Similarly, greater teaching experience improves a teacher’s ability to manage diverse classroom situations and implement effective teaching approaches. Thus, effective professional development programs should account for these factors to enhance teacher competence holistically.

The study also revealed that the supplementary training program designed to support teachers' professional development had a positive impact. The program not only provided targeted skills and strategies but also fostered a

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mindset of lifelong learning among the participants. Teachers demonstrated motivation and a willingness to enhance their skills by actively engaging in the training and by creating action plans. These plans outlined specific learning goals, including additional training programs they wished to pursue, indicating a proactive approach to their professional growth. Moreover, the study found that teachers began to form learning communities with their colleagues, often leveraging social media platforms to collaborate and share best practices. These communities serve as informal networks for peer support, resource sharing, and continuous professional dialogue. By engaging in these collaborative efforts, teachers created a culture of mutual learning and ongoing professional development, which has the potential to enhance teaching practices and student outcomes.

IV. CONCLUSION

The professional development program for novice teachers showed positive results through the developed training program. More than half teachers could participate optimally in the training stages, improving their competence in modifying innovative science teaching strategies. However, some teachers still needed help in the training process due to factors such as their educational background and teaching experience. It was found that teachers with a closer educational background and higher teaching experience had better pedagogical competence, including modifying teaching strategies to make them more innovative. The study also found that the supplementary training program positively impacted teachers' professional development, enhancing skills and fostering lifelong learning. Teachers showed motivation by creating action plans with specific learning goals. They also formed learning communities via social media, promoting collaboration, peer support, and continuous professional growth, which can improve teaching practices and student outcomes.

REFERENCES

Pambudi, B. A., & Gunawan, I. (2019, December). Instructional leadership as an effort to increase teacher professionalism in the industrial revolution era 4.0. In *The 4th International Conference on Education and Management (COEMA 2019)* (pp. 216-220). Atlantis Press.

Åkerblad, L., Seppänen-Järvelä, R., & Haapakoski, K. (2021). Integrative strategies in mixed methods research. *Journal of Mixed Methods Research*, *15*(2), 152–170.

Alenezi, A. (2020). The role of e-learning materials in enhancing teaching and learning behaviors. *International Journal of Information and Education Technology*, *10*(1), 48–56.

Zulela, M. S., Neolaka, A., Iasha, V., & Setiawan, B. (2022). How is the education character implemented? The case study in Indonesian elementary school. *Journal of Educational and Social Research*, *12*(1), 371.

Garzón Artacho, E., Martínez, T. S., Ortega Martin, J. L., Marin Marin, J. A., & Gomez Garcia, G. (2020). Teacher training in lifelong learning—The importance of digital competence in the encouragement of teaching innovation. *Sustainability*, 12(7), 2852.

Bragg, L. A., Walsh, C., & Heyeres, M. (2021). Successful design and delivery of online professional development for teachers: A systematic review of the literature. *Computers & Education*, 166, 104158.

Cabero-Almenara, J., Guillén-Gámez, F. D., Ruiz-Palmero, J., & Palacios-Rodríguez, A. (2022). Teachers' digital competence to assist students with functional diversity: Identification of factors through logistic regression methods. *British Journal of Educational Technology*, *53*(1), 41-57.

Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu). *European Journal of Education*, *54*(3), 356-369.

Fauth, B., Decristan, J., Decker, A. T., Büttner, G., Hardy, I., Klieme, E., & Kunter, M. (2019). The effects of teacher competence on student outcomes in elementary science education: The mediating role of teaching quality. *Teaching and Teacher Education*, *86*, 102882.

Jacob, F., John, S., & Gwany, D. M. (2020). Teachers' pedagogical content knowledge and students' academic achievement: A theoretical overview. *Journal of Global Research in Education and Social Science*, *14*(2), 14–44.

Herwin, H., Hastomo, A., Saptono, B., Ardiansyah, A. R., & Wibowo, S. E. (2021). How elementary school teachers organized online learning during the covid-19 pandemic?. *World Journal on Educational Technology: Current Issues*, *13*(3), 437-449.

Howard, S. K., Tondeur, J., Ma, J., & Yang, J. (2021). What to teach? Strategies for developing digital competency in preservice teacher training. *Computers & Education*, *165*, 104149.

Irmayani, H., Wardiah, D., & Kristiawan, M. (2018). The strategy of SD Pusri in improving educational quality. *International Journal of Scientific & Technology Research*, *7*(7), 113-121.

Kennedy, M. M. (2016). How does professional development improve teaching?. *Review of Educational Research*, *86*(4), 945-980.

Komalasari, K., Arafat, Y., & Mulyadi, M. (2020). Principal's management competencies in improving the quality of education. *Journal of Social Work and Science Education*, *1*(2), 181-193.

König, J., Bremerich-Vos, A., Buchholtz, C., Fladung, I., & Glutsch, N. (2020). Pre–service teachers' generic and subject-specific lesson-planning skills: On learning adaptive teaching during initial teacher education. *European Journal of Teacher Education*, *43*(2), 131-150.

Konopka, C. L., Adaime, M. B., & Mosele, P. H. (2015). Active teaching and learning methodologies: some considerations. *Creative Education*, *6*(14), 1536-1545.

Kusumaningrum, D. E., Sumarsono, R. B., & Gunawan, I. (2019). Professional ethics and teacher teaching performance: Measurement of teacher empowerment with a soft system methodology approach. *International Journal of Innovation, Creativity and Change*, *5*(4), 611-624.

Lapitan Jr, L. D., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. (2021). An effective blended online teaching and learning strategy during the covid-19 pandemic. *Education for Chemical Engineers*, *35*, 116-131.

Lepp, L., Aaviku, T., Leijen, Ä., Pedaste, M., & Saks, K. (2021). Teaching during COVID-19: The decisions made in teaching. *Education Sciences*, *11*(2), 47.

Istiyono, E., Kartowagiran, B., Retnawati, H., Cahyo Adi Kistoro, H., & Putranta, H. (2021). Effective teachers' personality in strengthening character education. *International Journal of Evaluation and Research in Education*, *10*(2), 512-521.

Murkatik, K., Harapan, E., & Wardiah, D. (2020). The influence of professional and pedagogic competence on teacher's performance. *Journal of Social Work and Science Education*, *1*(1), 58-69.

Oke, A., & Fernandes, F. A. P. (2020). Innovations in teaching and learning: Exploring the perceptions of the education sector on the 4th industrial revolution (4IR). *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(2), 31.

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital Science and Education*, *2*, 923-945.

Rasmitadila, R., Rachmadtullah, R., Samsudin, A., Tambunan, A., Khairas, E., & Nurtanto, M. (2020). The benefits of implementation of an instructional strategy model based on the brain's natural learning systems in inclusive classrooms in higher education. *International Journal of Emerging Technologies in Learning (iJET)*, *15*(18), 53-72.

Rusilowati, U., & Wahyudi, W. (2020, March). The significance of educator certification in developing pedagogy, personality, social and professional competencies. In *2nd Social and Humaniora Research Symposium (SoRes 2019)* (pp. 446-451). Atlantis Press.

Sancar, R., Atal, D., & Deryakulu, D. (2021). A new framework for teachers' professional development. *Teaching and Teacher Education*, *101*, 103305.

Sulaiman, J., & Ismail, S. N. (2020). Teacher competence and 21st century skills in transformation schools 2025 (TS25). *Universal Journal of Educational Research*, *8*(8), 3536-3544.

Suryawati, E., & Osman, K. (2017). Contextual learning: Innovative approach towards the development of students' scientific attitude and natural science performance. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(1), 61-76.

Wardani, I. U., Arnyana, I. B. P., & Dantes, N. (2023). Analysis of science learning problems in elementary schools. *Jurnal Penelitian Pendidikan IPA*, *9*(7), 5645-5652.

Yurtseven Avci, Z., O'Dwyer, L. M., & Lawson, J. (2020). Designing effective professional development for technology integration in schools. *Journal of Computer Assisted Learning*, *36*(2), 160-177.