

TEACHING OF CELL DIVISION THROUGH INTEGRATION OF VARIOUS TECHNOLOGIES

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ABSTRACT

This study aimed to identify the type of technology used by the student teachers in the teaching of cell division as well as the type of technology they frequently used. Using descriptive method through observation and a semi-structured interview, the study involved four student teachers in biology from one public school in the Philippines. The findings of the study were analyzed using the rubric of technology integration in the implementation of the use of technology in learning and teaching developed by Britten and Cassady (2005). The identified technologies were the internet, whiteboard & marker, microscope, LCD projector, tablet, mobile phones, laptop and Smart TV. The technologies frequently used by the teachers were internet, lap top, Smart TV and LCD projector. The teaching strategies that combined with the technology used are lecture style method, small group discussion and simulation through games. Challenges in the integration of technology include difficulty to employ specific teaching strategies to match with the technology used, limited availability of technology, complicated technology delivered, and lack of knowledge and skills in using and developing technology as media and biology learning resource. The findings suggest that student teachers that will become future teachers of science need the development of the ability to integrate other innovative types of technology in their lessons through proper training and attendance to workshops.

Keywords: Rubric, semi-structured interview, student teacher, technology integration.

INTRODUCTION

Technology use in education has become an increasingly important area of research during the past several decades. It has been observed that technology is being used as a medium to encourage inquiry, enhance communication, construct teaching materials, and assist students' self-expression (Efe, 2011). Habler, et al. (2015) supports that the importance of technology for science in schools is impossible to ignore, as its use has the potential to contribute to science teaching and learning by supporting exploration and experimentation. Likewise, the authors added that technology contributes to science teaching and learning by supporting collective knowledge-building, improving motivation and engagement, offering learners more responsibility and control, and helping students to visualize processes more clearly. Generally, *technology* in classroom-related activities refers to computers and videos and the associated hardware, networks, and software that enable them to function (Palomino, 2017). Technology has an effective role in moving from teacher-centered learning activities to student-centered learning activities.

Teachers' effective learning requires the use of efficient technology where they are expected to keep up with the latest technological developments. In so doing, the teachers can learn by using technology that suits the needs of students to become effective and efficient learning.

Very interesting to note is the kind of technology that the student teachers use to achieve individual goals in specific situations or environments as well as support the learning process. Thus, this study aimed to identify the types of technology used by the student teachers in teaching cell division as well as determine the type of technology most frequently used in the teaching-learning process.

LITERATURE REVIEW

Today, the development of information technology requires teachers to have various competencies in implementing effective and efficient learning. Through the various technologies available today, teacher and students must be able to use technology in learning (Suryawati, et al., 2017). Koh, et al. (2015) opined that in order for teachers to plan and implement effective and efficient learning, they should have good knowledge of pedagogical technology and knowledge in addition to having good conceptual mastery. Integration of technological knowledge, pedagogy, and content is conceived within the TPACK conceptual framework developed from the conceptual framework of PCK Lee Shulman (Harris & Hoffer, 2017). Koehler & Mishra (2015) reported that Technology, Pedagogical, Content Knowledge (TPACK) is a framework built on the interaction of three basic knowledge bases -technology, pedagogy, and content to produce effective learning by integrating technology.

Student teaching is a college-supervised instructional experience; usually the culminating course of the teacher education program. Student teaching provides pre-service teachers an experience and the space and opportunity to learn how to ask important questions about teaching and learning. It also allows knowing students by observing and interacting with them consistently over time. Likewise, student teaching applies strategies, theories, models and newly acquired knowledge in a variety of contexts within and across classrooms. It also allows doing an experiment with design and adapts practice according to learners' needs. During the student teaching experience, pre-service teachers are guided and instructed by two key individuals-the cooperating teacher or mentor, and the university adviser as counterpart. The university adviser and the mentor work collaboratively to support the growth and development of the student teacher.

During initial teacher education, student teachers are more willing to learn and use educational technology in their classroom practices. Some reports (Cubeles, & Riu, 2018; Meredith et al., 2017; Salleh, S.M., 2018) revealed that experienced teachers seem reluctant to include educational technology in schools, while student teachers and even newly qualified teachers are more confident users of educational technology. However, whether student teachers or experienced teachers, Smarkola (2008) believed the need for extra computer-integrated training as this was revealed in her study involving 160 student teachers and 158 experienced teachers. Beschorner & Kruse (2016) reported that pre-service teachers viewed computer technology as a useful tool for personal and professional development. Francis (2017) opined the need for the development of educational technology pedagogies although many initial teacher education programmes provide appropriate support for new teachers to develop their skills. Being technologically competent allows teachers to use computers and other digital gadgets as a part of the curriculum and as tools for authentic student engagement and learning (Anderson & Groulx, 2015).

METHODOLOGY

A. The Research Subjects

Participants observed were graduating student teachers majoring in biology in a state university. The selected research subjects were on their last year in college where they had their teaching practicum in the laboratory high school of a state university for the first semester of SY 2017-2018. Subjects were chosen purposively as they were the four (4) student teachers in biology for the said school year.

B. Data Collection and Data Analysis

The research data was collected through an observation sheet of instructional learning adapted from Harris, Grandgenett and Hofer (2010). Data collection was done in five (5) days which was exactly the number of days for discussing about cell division, specifically, mitosis and meiosis. Likewise, data was also collected from semi-structured interviews with each student teacher. The collected data was then analyzed using a Rating Technologies (TIAI) analysis developed by Britten and Cassady (2005).

RESULTS

In general, the various technologies used by the student teachers in teaching cell division involved the combined use of a variety of technology in the form of the internet, lap top, tablet, LCD projector, Smart TV, mobile phone, microscope and the whiteboard and its markers as indicated in Table 1. Based on the rubric of Harris, Grandgenett and Hofer (2010), the various technologies selected for use in the lesson plan by the student teachers are found strongly aligned with one or more of the curriculum goals or objectives of the school. As indicated in the lesson plan, the use of technology is integrated in the curriculum of high school biology as it aims to provide an easy and clear understanding of the concept of cell division. Moreover, the use of various technologies optimally supports the lecture style method, small group discussion and simulation through games. In addition, the student teachers' selection of the various technologies in teaching cell division are exemplary given the specific objectives of the lesson and the specific teaching strategies used. Finally, the lesson prepared, the specific strategies employed and the various technologies used fit strongly together within the lesson plan.

Table 1. Various technologies used by teachers in learning the concept of Cell Division

Student Teacher	Kind of Technology Used
Student Teacher 1	Internet for video animation* Lap top* Mobile phone LCD projector* Microscope Whiteboard and markers
Student Teacher 2	Whiteboard and markers Lap top* Mobile phone Internet for video animation* LCD projector* Microscope

Student Teacher 3	Internet for video animation* Lap top* Smart TV* LCD projector* Mobile phone Microscope Whiteboard and markers
Student Teacher 4	Tablet LCD projector* Smart TV* Whiteboard and markers Microscope Internet for video animation*

**most frequently used*

DISCUSSION

The use of the Internet via mobile phones by the student teachers was the source and means of learning through employing the traditional lecture style method. Specifically, when Student Teachers 1, 2 and 3 asked the class about the meaning of reductional and equational divisions, they told the students to use their mobile phones. Similarly, when the three (3) student teachers had a lecture on synapsis, homologous chromosomes and cytokinesis, respectively, they had to ask the students to use their cell phones to immediately look for the meaning of the concepts. The selection of the mobile phone as a learning support tool was possible because almost every student's mobile phone could be used to search for information on the internet. However, the student teachers did not use their own mobile phones in the teaching-learning process. As the student teachers discussed the terms, she used a personal laptop and an LCD projector to project the information. Observations also indicate that the use of mobile phones for student learning was for resourcing and searching. Resourcing implies the aim of learning as a teaching resource or information repository for information and data related to the learning materials. On the other hand, searching is a search process to complete the learning resource materials that will be delivered to students. According to the student teachers, the use of the internet via mobile phones was to allow the students to become more actively involved and to serve as a resource material for learning. Safitri, et al. (2017) supports that the Internet as a medium for teaching cell division, may help to understand the material and increase the activity and motivation of students so that students do not feel bored in learning activities.

Similarly, the use of the Internet for video animations via a lap top projected through an LCD projector was very useful to show that mitosis and meiosis are dynamic as the chromosomes move. As observed in all of the student teachers, they used this technology as it was very important for the students to see the process in action. Where there was no available LCD projector, a Smart TV was used instead, or vice versa. Likewise, when the lap top was not available, a tablet was used instead, or vice versa. When the student teachers presented the video animations using the lecture style method, they blended the animation with interactive experiences such as asking questions to emphasize main concepts. As observed, the student teachers seemed to use the approach, "The Pause Procedure" which Bachhel & Thaman (2014) describe as an extremely easy and effective approach to promote greater student participation with a little use of the traditional lecture presentations. This procedure has the teacher pausing for approximately two minutes on three to four occasions during a fifty-minute lecture (i.e., every 12-15 minutes). The teacher's asking of questions is done during the pauses, where the

students may answer right away or work in pairs to discuss. For example, when discussing the stages of mitosis using a video animation, Student Teacher 3 paused and asked “how do you describe the chromosomes in prophase?” Initially, the student teacher gave the students information about the “what we know” and this involves students’ learning of the correct order of the stages of mitosis using the hand activity. But what really is important for the students is the “how do we know?” about these stages of mitosis. To enhance learning, the student teacher explained further the details of the characteristics of the stages of mitosis in order to compare the characteristics of each stage of mitosis. Some of the great animations online that were used by the student teachers to show the students an animated demonstration of mitosis and meiosis in action were Stages of Mitosis, How Meiosis Works and Independent Assortment (Meiosis Orientation of Chromosomes) (for Student Teacher 1), Stages of Meiosis and Virtual Cell: Mitosis (for Student Teacher 2). Another good resource that the student teachers used was this interactive explanation from CellsAlive or this mitosis animation from McGraw-Hill (for Student Teacher 3), and, Virtual Cell: Mitosis and How Meiosis Works (for Student Teacher 4).

The student teachers allowed the students to use either a tablet or a mobile phone in playing an online game about cell division. Simulations like games allow learners the opportunity to model, explore, and try out a variety of strategies. This is supported by Khenissi, et al. (2015) who affirm that games and modeling activities can elicit curiosity, create a demand for knowledge, and enable students to discover knowledge through exploration. Specifically, Student Teacher 1 allowed his class to play an online game, Game: The Cell Cycle which was about the cell cycle and the stages of mitosis. Student Teacher 2 allowed the class to play Mitosis and Meiosis Review Game which is a game on both mitosis and meiosis. Student Teacher 3 allowed his class to play the game, Mitosis Mover Game which was a game on mitosis. Finally, Student Teacher 4 asked her class to play Mitosis and Meiosis Quiz Review Game which was also played by the students of Student Teacher 2. The game each of the student teachers presented was the perfect way to review the concept of mitosis and meiosis. Because these concepts are important for many biology topics, ensuring comprehension through activities like this is vital. As each of the student teachers shouted “start”, the students played the game. Everybody was observed playing the game actively. As observed, the student teachers allowed their classes to play the game for about 10 minutes. At the end of each game, Student Teachers 1, 2 and 3 had to use their mobile phones to summarize the key concepts. Meanwhile, Student Teacher 4 used her tablet to make clarifications. In the final interview, the student teachers said that they used either a cell phone or a tablet during the game depending on which one was completely charged and available.

The next kind of technology used by the student teachers was the microscope. Since the student teachers teach in the same school, it was a common exercise of using the microscope in describing the events of cell division. Ruscic, et al. (2018) find the microscope very useful and informative as it provides considerable clarity in describing the process of mitosis in higher eukaryotes. Through small group discussion, the student teachers allowed the student to observe by group a slide containing stained onion root tips. As all the student teachers informed the students that the cells in the slide are in various stages of mitosis, they asked each group to examine the onion cells in the slide into focus using the low power objective (LPO), then using the high power objective (HPO). The students were actively interacting with the student teachers as they raised their hands to show what they visualized under the microscope. As also observed, the students had to go from one group to another in order to compare the results of their investigation.

The last technology used by the student teachers is a whiteboard which may not be always available in all schools. Others might think that whiteboard is not a technology tool but Schneider (2018) confirms that whiteboard is a device (hardware) or media or messaging/material used with a lap top and LCD projector. As observed in the school where the student teachers teach, the whiteboard in the classroom was used as a vehicle for channeling messages or information about a specific lesson. This media can arouse students' motivation to learn. For example, when Student Teacher 1 showed a video animation of mitosis, she stopped for a while in her discussion as she went to the whiteboard, used a marker and emphasized on the board how the microtubules connect to the chromosomes, help chromosomes complete their first split, and move the new chromosomes to their places in the new daughter cells. Similarly, Student Teacher 2 made an emphasis as she illustrated on the whiteboard the formation of tetrad during synapsis. Moreover, Student Teacher 3 and Student 4 went to the board and illustrated cytokinesis for more clarification.

Meanwhile, the technologies most frequently used by the teachers were internet for video animation, lap top/Smart TV and LCD projector as they use these technologies very often when they discussed the stages of mitosis (prophase, metaphase, anaphase and telophase) and meiosis I and meiosis II.

Based on the results of the analysis of the use of various learning technologies in the implementation of the use of technology in learning and teaching developed by Britten & Cassady (2005), the use of technology in teaching by the student teachers in the laboratory school of a state university belongs to the Essential Technology Component. As observed, equipment and technologies are built into lesson design and objectives are discussed within the context of the lesson and not as an external component. Likewise, the lesson on mitosis and meiosis requires the use of technology as it facilitates biology learning. Observations show that the technology in the form of the internet, lap top, tablet, LCD projector, Smart TV, mobile phone, microscope and the whiteboard and its markers is used by the student teachers for presenting materials via the lecture style method, small group discussion and simulation through games. Though the lecture style method is a conventional method of teaching, the discussion becomes dynamic as the student teacher discusses concepts through a projector infocus or a Smart TV. Some authors (Liu & Cheng, 2015; Amin, et al., 2018) agree that the multimedia projector is a technology tool to facilitate the learning process. During the final interview, the student teachers mentioned that some schools may have limited facilities and this is the reason why the teachers cannot use technology at all times. Another obstacle mentioned had something to do with the use of technology, that is, it is possible that there is the lack of teachers' skills in using technologies such as using some application usage search and installation of technological devices such as the LCD projector and the Smart TV that still require some accessories for operation. Moreover, the student teachers added that it is possible that not all the teachers are open to using all the kinds of technology they specifically used in the study especially in looking for online games and video animations because proper selection and initial preview are needed and this means a lot of time and preparation. This also implies lack of knowledge and skills of teachers in the use of computer-based technology because it is possible that the teachers have not been trained on technology in learning at the school level. Sheffield & McIlvenny (2014) emphasize the role of technology which is to simplify and accelerate the learning process of the students as well as provide fun for students as they interact with colors, images, sound and video. This means that use of technology becomes a very important factor for effective learning because it can evoke positive emotions during the learning process. Moreover, as observed in the student teachers' lessons, the role of technology depends on the content material that will be taught by the teacher. As cell division is abstract

and too complex to understand, technology is important to use to explain mitosis concepts completely. According to the student teachers, the important concepts that should be known by the students include the important events that take place in prophase, metaphase, anaphase and telophase of mitosis as well as in meiosis I and meiosis II. By using technology in the form of the internet, lap top, tablet, LCD projector, Smart TV, mobile phone, microscope and the whiteboard and its markers about cell division, the student teachers feel that because of the active participation of the students, the lesson has been well-understood.

CONCLUSIONS

Various technologies used by the student biology teachers in the laboratory high school of a state university support the students' learning process. The type of technology used consists of internet, lap top, tablet, LCD projector, Smart TV, mobile phone, microscope and the whiteboard and its markers tailored to the existing facility of the school. As the mentioned technologies were effectively used in their teaching of cell division, the student teachers still recognized some obstacles in the integration of technology that may be observed among the teachers in the other schools. These challenges are access to limited technology, complicated nature of technology used, difficulty to match a specific teaching strategy to a specific technology and teacher's lack of knowledge and skills in using and developing technology as media and learning resource.

With the kind of technologies identified in the study, the findings suggest that student teachers that will become future teachers of science need the development of the ability to integrate other innovative types of technology such as other platforms like EDMODO, Google classroom, Moodle and the like through proper training and attendance to workshops.

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