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Improving Learning Achievement by Applying the Pakem Learning Model

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ABSTRACT

Background. The success of the teaching and learning process in the classroom will be largely determined by the learning strategy, no matter how complete and clear the other components are, if they are not applied through the right strategy, then these components will have no meaning in the process of achieving goals.

Purpose. Therefore, every teacher who will teach is required to apply certain methods or strategies in the implementation of his learning

Method. While the objectives of this study are: (a) Want to know the increase in student learning achievement after the application of the learning strategy of improving thinking skills, (b) Want to know the effect of student learning achievement after applying the PAKEM learning model.

Results. This research uses action research (action research) as much as 2 rounds, each round consists of four stages, namely: design, activities and observations, reflection, and revision.

Conclusion. The targets of this study were fourth grade students at SDIT Al Manar Purwakarta. Data obtained in the form of formative test results, observation sheets of teaching and learning activities.

KEYWORDS

Learning, Pai, Pakem

INTRODUCTION

In teaching and learning activities that take (Zhang dkk., 2019), there has been an interaction that aims the teacher and students who (Mearsheimer, 2019) . This interaction is because it is the teacher who interprets it by creating an environment that has educational value for the benefit of students in learning. Teachers want to provide the best service for (Lindgren dkk., 2020), by providing a pleasant and encouraging (Campanale dkk., 2020). Teachers try to be good mentors with a wise and wise (Kany dkk., 2019), so as to create a harmonious two-way relationship between teachers and (Lindgren dkk., 2020). In teaching, teachers must be good at using a wise and wise (Zheng dkk., 2020), not carelessly which can harm their students. The teacher's view of students will determine attitudes and

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(Lin dkk., 2020). Every teacher does not always have the same view in assessing students. This will affect the approach the teacher takes in (Botchkarev, 2019).

The realization of achieving these (Hughes dkk., 2019), there are teaching and learning interaction (Barredo Arrieta dkk., 2020), especially those that occur in the (Xu & Zammit, 2020). (Ferlay dkk., 2019), the activity is how the relationship between the teacher or teaching material is designed and with (Shah dkk., 2020). This interaction is a communication process of delivering learning (Hudson dkk., 2019). This is in line with what was stated by Arief S Sadiman who stated that the teaching and learning process is essentially an interaction (Attia dkk., 2019). The interaction process is the process of delivering messages through media channels / techniques / methods to message (Ludwig dkk., 2019).

In line with recent learning innovations including in elementary (Tinanoff dkk., 2019), namely: PAKEM. The teaching and learning interaction requires students to be (Tomeh dkk., 2019), creative and happy which optimally involves their mental and (Dwivedi dkk., 2021). Their level of (Long dkk., 2022), creativity and enjoyment in learning is a continuum from the lowest to the (Wu dkk., 2021). But ideally on the highest continuum both the mental and physical aspects of students are (Campanale dkk., 2020). (Chan dkk., 2020), teaching and learning interactions with the PAKEM paradigm require children to:

1.Doing
2.Engage in activities
3.Visually observing
4 Absorbing information verbally

Thus, teaching and learning interactions should ideally be able to teach students based on problem-based (Ozturk dkk., 2020), authentic (Dwivedi dkk., 2021), inquiry-based learning, project-based learning, service learning, and cooperative learning. The interaction pattern that is able to package this can change the active learning paradigm into a reflective learning (Abiri dkk., 2019).

In order for this result to occur (Guo dkk., 2020) , teachers are required to change their roles and functions to become (Harapan dkk., 2020), (Bae dkk., 2019), students' learning (Hughes dkk., 2019), and evaluators. This means that teachers must create democratic and dialogic learning interactions between teachers and students, and students and students.

The success of learning objectives is determined by many (Pettersen dkk., 2021), including the teacher factor in carrying out the teaching and learning (Farhood dkk., 2019), because the teacher can directly (Ubando dkk., 2020), foster and improve the intelligence and skills of his (Kremer dkk., 2020). To overcome the above problems to achieve maximum educational (American Diabetes Association, 2019), the role of the teacher is very important and the teacher is expected to be able to convey all the subjects listed in the learning process appropriately and in accordance with the concepts of the subjects to be conveyed .

By realizing the reality above, then in this study the authors took the title "Efforts to Improve PAI Learning Achievement by Applying the PAKEM Learning Model to Fourth Grade Students of SDIT Al Manar Purwakarta".

RESEARCH METHODOLOGY

B. Literature Review

According to psychological understanding, learning is a process of (Moriguchi dkk., 2020), namely changes in behavior as a result of interaction with the environment in meeting their needs. These changes will be evident in all aspects of (Knuuti dkk., 2020). The definition of learning can also be

interpreted as follows: "Learning is a process or effort made by a person to obtain a new change in behavior as a whole, as a result of his own experience in interaction with the environment".
According to experts, including according to R. Gagne, there are two definitions of learning, namely: 1) learning is a process to obtain motivation in knowledge, skills, habits and behavior, 2) learning is the mastery of knowledge or skills obtained from instruction. (Slameto.2010: 2)

The PAKEM model is a learning model that rests on four principles, namely: active, effective, and fun. This learning model is very suitable for competency-based which is always oriented towards student activities (student centered learning). This model can be developed simply by teachers by paying attention to the PAKEM principles.

The PAKEM model is process and goal oriented. The process orientation in the PAKEM model seeks to increase learning motivation. Independence and responsibility are fostered from the start, not only that, togetherness and cooperation are also to hone the emotional. Healthy competition is fostered by respecting each other and fostering leadership attitudes. The goal orientation is that children learn more deeply, children are more critical and creative, the learning atmosphere becomes more varied and increases emotional maturity. No less important, children are ready to face change and participate in the process of change.

It seems that the meaning of active, creative, effective and fun is still too abstract. Some educators are still vague about this meaning. Although the meaning of the term has been discussed by educators, it does not mean that this meaning is patent. The meaning still needs to be developed again according to the actual conditions. In the discussion, it can be concluded as follows:

1. **On**
   Always try, Don't want to be a spectator, Utilize learning modalities (visual, auditory, or kinesthetic), Attentive in every learning process.
2. **Creative**
   Wanting new changes, Wanting to make innovations, Having many ways to do things, Not quickly despairing, Not easily satisfied with the results of his work and always want to do more, Fostering motivation, self-confidence, and critical, Have many ways to do things.
3. **Effective**
   Utilizing teaching aids that are around, Invited to learning sources, making observations, Utilizing the time available, Utilizing the right summary, Optimizing the five senses, Organizing learning strategies.
4. **Fun**
   Attractive teacher appearance, Unidirectional learning atmosphere, Rich in methods, Non-boring class design, Learning while playing and singing, Children's learning results are displayed in the classroom, Closer to the real world, There are awards for achievers.

Learning can bring about a change in the individual who learns. This change is an experience of behavior from less good to better. Experience in learning is an experience that is aimed at the results that students will achieve in the learning process at school. According to Poerwodarminto (1991: 768), learning achievement is the result achieved (done, done), in this case learning achievement is the result of work, the result of creation by someone who is obtained with careful work and a struggle that requires thought.

Based on the description above, it can be said that learning achievement is achieved by students by involving all their potential after the student has carried out learning activities. The achievement of these learning outcomes can be known by conducting a learning outcomes test assessment. The assessment is held to determine the extent to which students have succeeded in

following the lessons given by the teacher. In addition, the teacher can also find out the extent of his success in the teaching and learning process at school.

In line with learning achievement, it can be interpreted that PAI learning achievement is the value obtained by students after involving directly/actively all the potential they have both cognitive (knowledge), affective (attitude) and psychomotor (skills) aspects in the teaching and learning process.

C. Collaboration

This research was conducted collaboratively between Islamic Religious Education subject teachers and researchers, where teachers and students play a very important role in the process of classroom action research. In this form, the main purpose of classroom action research is to improve learning practices in the classroom.

The observation process is carried out on the implementation of the action by using the observation sheet that has been made to see the activities of teachers and students during the learning process. The target of observing student activity in this study is the activity of students who listen to motivation from the teacher, students who ask questions, responses or comments, student activity in observing the problems given by the teacher and looking for answers to the problems given, students who provide questions and responses from other students, students who are active in working on the worksheets given, active students in asking questions if they have difficulty as well as students' skills in responding to questions from the teacher or other students, student activity in drawing learning conclusions and students who do not concentrate during the teaching and learning process.

D. Place and Subjects studied

The research was conducted at SDIT Al Manar Purwakarta, Ipik Gandamanah Street, Kp Rawamekar, Rt 02, Rw 01, Kec. Tegalmunjul, Kec Purwakarta, Kab. Purwakarta zip code 41111, with the Subjects of Research are students and students of class IV A Abu Dzar Al Ghifari with a total of 25 people..

E. Pre-Action

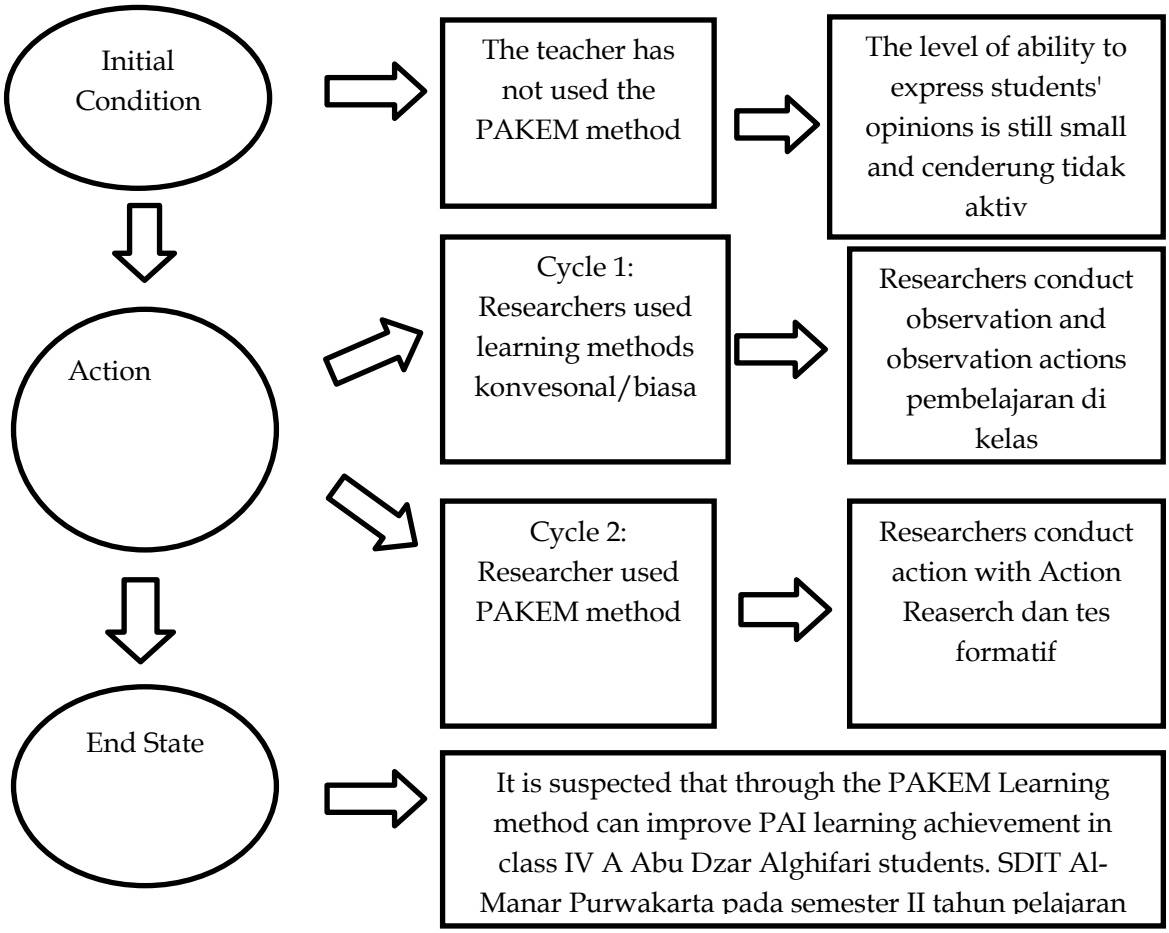
During this time, the teacher more often uses conventional methods, namely lectures and interspersed with questions and answers. Each student gets the same task as other students. The teacher dominates during the learning process while students mostly listen and pay attention to the explanation delivered by the teacher.

There are still few opportunities for students to express their opinions. Teaching and learning activities seem monotonous so that it does not provide motivation for students to learn. Students only write and listen to explanations delivered by the teacher, so they are only motivated to remember and memorize material.

The data collected in this study include information data about the state of students seen from qualitative and quantitative aspects. Qualitative aspects are in the form of data from observations, interviews, document or archive studies based on observation sheets and questionnaires that describe the learning process in the classroom. The quantitative aspect in question is the results of the learning assessment of the subject matter of the reaction rate in the form of scores obtained by students from the assessment of abilities in the form of cognitive aspects and affective aspect

RESULT AND DISCUSSION

CONTEXTUAL FRAMEWORK



HYPOTHESIS

Ho: There is no effectiveness of the conventional learning model (Lectures and Questions and Answers) on the ability of PAI learning achievement in class IV A Abu Dzar Alghifari students.

H1: There is an effectiveness of PAKEM learning model on PAI learning achievement of fourth grade students of Abu Dzar Alghifari A.

- **Cycle I**

  Based on the analysis of Cycle 1, it is explained that by applying PAKEM learning, the average value of student learning achievement is 73.48 and learning completeness reaches 31% or there are 8 students out of 25 students who have completed learning. These results show that in the first cycle classically students have not completed learning, because students who get a score of 75 □ are only 31% smaller than the desired percentage of completeness which is 85%. This is because students still feel new and do not understand what the teacher means and uses by implementing PAKEM learning. .

- **Cycle II**

  Based on the analysis of cycle II, the average value of student learning achievement was 82.08 and learning completeness reached 72% or there were 19 students out of 25 students who had completed learning. The results in cycle II have improved better than cycle I. The increase in

learning outcomes in cycle II is influenced by an increase in the number of students who have completed the learning process.

the teacher's ability to implement PAKEM learning so that students can more easily understand the material that has been given.

CONCLUSION

PAKEM learning in Sdit Al Manar Purwakarta can improve the quality of Islamic Religious Education learning. The positive impact in improving student learning achievement in the classroom is characterized by an increase in student learning completeness in each cycle, namely in cycle I reaching 45% and in Cycle II reaching 75%.

The positive influence of student behavior is being able to work independently and in groups, and being able to be responsible for all individual and group assignments can also increase student motivation, interest, and participation in learning Islamic Religious Education subjects..

H. Advice

From the research results obtained, in order to create a more effective and optimal Islamic Religious Education learning atmosphere for students, the following suggestions are made: 1) To implement PAKEM requires careful preparation, so the teacher must be able to determine or choose topics that can really be applied with PAKEM learning in the teaching and learning process so as to obtain optimal results. 2) In learning, it is better to have a learning method that can provide better benefits for students from an academic and non-academic perspective.

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AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

Author 4: Formal analysis; Methodology; Writing - original draft.

REFERENCES

Abiri, R., Borhani, S., Sellers, E. W., Jiang, Y., & Zhao, X. (2019). A comprehensive review of EEG-based brain–computer interface paradigms. *Journal of Neural Engineering*, *16*(1), 011001. https://doi.org/10.1088/1741-2552/aaf12e

American Diabetes Association. (2019). 9. Pharmacologic Approaches to Glycemic Treatment: *Standards of Medical Care in Diabetes—2019*. *Diabetes Care*, *42*(Supplement_1), S90–S102. https://doi.org/10.2337/dc19-S009

Attia, Z. I., Noseworthy, P. A., Lopez-Jimenez, F., Asirvatham, S. J., Deshmukh, A. J., Gersh, B. J., Carter, R. E., Yao, X., Rabinstein, A. A., Erickson, B. J., Kapa, S., & Friedman, P. A. (2019). An artificial intelligence-enabled ECG algorithm for the identification of patients with atrial fibrillation during sinus rhythm: A retrospective analysis of outcome prediction. *The Lancet*, *394*(10201), 861–867. https://doi.org/10.1016/S0140-6736(19)31721-0

Bae, J., Kim, S. J., Kim, K. H., & Koo, D.-M. (2019). Affective value of game items: A mood management and selective exposure approach. *Internet Research*, *29*(2), 315–328. https://doi.org/10.1108/INTR-12-2017-0477

Barredo Arrieta, A., Díaz-Rodríguez, N., Del Ser, J., Bennetot, A., Tabik, S., Barbado, A., Garcia, S., Gil-Lopez, S., Molina, D., Benjamins, R., Chatila, R., & Herrera, F. (2020). Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI. *Information Fusion*, *58*, 82–115. https://doi.org/10.1016/j.inffus.2019.12.012

Botchkarev, A. (2019). A New Typology Design of Performance Metrics to Measure Errors in Machine Learning Regression Algorithms. *Interdisciplinary Journal of Information, Knowledge, and Management*, *14*, 045–076. https://doi.org/10.28945/4184

Campanale, Massarelli, Savino, Locaputo, & Uricchio. (2020). A Detailed Review Study on Potential Effects of Microplastics and Additives of Concern on Human Health. *International Journal of Environmental Research and Public Health*, *17*(4), 1212. https://doi.org/10.3390/ijerph17041212

Chan, J. F.-W., Yuan, S., Kok, K.-H., To, K. K.-W., Chu, H., Yang, J., Xing, F., Liu, J., Yip, C. C.-Y., Poon, R. W.-S., Tsoi, H.-W., Lo, S. K.-F., Chan, K.-H., Poon, V. K.-M., Chan, W.-M., Ip, J. D., Cai, J.-P., Cheng, V. C.-C., Chen, H., … Yuen, K.-Y. (2020). A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: A study of a family cluster. *The Lancet*, *395*(10223), 514–523. https://doi.org/10.1016/S0140-6736(20)30154-9

Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., Eirug, A., Galanos, V., Ilavarasan, P. V., Janssen, M., Jones, P., Kar, A. K., Kizgin, H., Kronemann, B., Lal, B., Lucini, B., … Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, *57*, 101994. https://doi.org/10.1016/j.ijinfomgt.2019.08.002

Farhood, B., Najafi, M., & Mortezaee, K. (2019). CD8 $^{+}$ cytotoxic T lymphocytes in cancer immunotherapy: A review. *Journal of Cellular Physiology*, *234*(6), 8509–8521. https://doi.org/10.1002/jcp.27782

Ferlay, J., Colombet, M., Soerjomataram, I., Mathers, C., Parkin, D. M., Piñeros, M., Znaor, A., & Bray, F. (2019). Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods. *International Journal of Cancer*, *144*(8), 1941–1953. https://doi.org/10.1002/ijc.31937

Guo, N., Lenzo, B., Zhang, X., Zou, Y., Zhai, R., & Zhang, T. (2020). A Real-Time Nonlinear Model Predictive Controller for Yaw Motion Optimization of Distributed Drive Electric Vehicles. *IEEE Transactions on Vehicular Technology*, *69*(5), 4935–4946. https://doi.org/10.1109/TVT.2020.2980169

Harapan, H., Wagner, A. L., Yufika, A., Winardi, W., Anwar, S., Gan, A. K., Setiawan, A. M., Rajamoorthy, Y., Sofyan, H., & Mudatsir, M. (2020). Acceptance of a COVID-19 Vaccine in Southeast Asia: A Cross-Sectional Study in Indonesia. *Frontiers in Public Health*, *8*, 381. https://doi.org/10.3389/fpubh.2020.00381

Hudson, B., Hunter, D., & Peckham, S. (2019). Policy failure and the policy-implementation gap: Can policy support programs help? *Policy Design and Practice*, *2*(1), 1–14. https://doi.org/10.1080/25741292.2018.1540378

Hughes, L., Dwivedi, Y. K., Misra, S. K., Rana, N. P., Raghavan, V., & Akella, V. (2019). Blockchain research, practice and policy: Applications, benefits, limitations, emerging research themes and research agenda. *International Journal of Information Management*, *49*, 114–129. https://doi.org/10.1016/j.ijinfomgt.2019.02.005

Kany, S., Vollrath, J. T., & Relja, B. (2019). Cytokines in Inflammatory Disease. *International Journal of Molecular Sciences*, *20*(23), 6008. https://doi.org/10.3390/ijms20236008

Knuuti, J., Wijns, W., Saraste, A., Capodanno, D., Barbato, E., Funck-Brentano, C., Prescott, E., Storey, R. F., Deaton, C., Cuisset, T., Agewall, S., Dickstein, K., Edvardsen, T., Escaned, J., Gersh, B. J., Svitil, P., Gilard, M., Hasdai, D., Hatala, R., … Clapp, B. (2020). 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. *European Heart Journal*, *41*(3), 407–477. https://doi.org/10.1093/eurheartj/ehz425

Kremer, S., Lersy, F., De Sèze, J., Ferré, J.-C., Maamar, A., Carsin-Nicol, B., Collange, O., Bonneville, F., Adam, G., Martin-Blondel, G., Rafiq, M., Geeraerts, T., Delamarre, L., Grand, S., Krainik, A., For the SFNR-COVID Group, Kremer, S., Adam, G., Alleg, M., … Cotton, F. (2020). Brain MRI Findings in Severe COVID-19: A Retrospective Observational Study. *Radiology*, *297*(2), E242–E251. https://doi.org/10.1148/radiol.2020202222

Lin, Q., Zhao, S., Gao, D., Lou, Y., Yang, S., Musa, S. S., Wang, M. H., Cai, Y., Wang, W., Yang, L., & He, D. (2020). A conceptual model for the coronavirus disease 2019 (COVID-19) outbreak in Wuhan, China with individual reaction and governmental action. *International Journal of Infectious Diseases*, *93*, 211–216. https://doi.org/10.1016/j.ijid.2020.02.058

Lindgren, B.-M., Lundman, B., & Graneheim, U. H. (2020). Abstraction and interpretation during the qualitative content analysis process. *International Journal of Nursing Studies*, *108*, 103632. https://doi.org/10.1016/j.ijnurstu.2020.103632

Long, H., Chang, C.-P., Jegajeevan, S., & Tang, K. (2022). Can Central Bank Mitigate the Effects of the COVID-19 Pandemic on the Macroeconomy? *Emerging Markets Finance and Trade*, *58*(9), 2652–2669. https://doi.org/10.1080/1540496X.2021.2007880

Ludwig, N., Whiteside, T. L., & Reichert, T. E. (2019). Challenges in Exosome Isolation and Analysis in Health and Disease. *International Journal of Molecular Sciences*, *20*(19), 4684. https://doi.org/10.3390/ijms20194684

Mearsheimer, J. J. (2019). Bound to Fail: The Rise and Fall of the Liberal International Order. *International Security*, *43*(4), 7–50. https://doi.org/10.1162/isec_a_00342

Moriguchi, T., Harii, N., Goto, J., Harada, D., Sugawara, H., Takamino, J., Ueno, M., Sakata, H., Kondo, K., Myose, N., Nakao, A., Takeda, M., Haro, H., Inoue, O., Suzuki-Inoue, K., Kubokawa, K., Ogihara, S., Sasaki, T., Kinouchi, H., … Shimada, S. (2020). A first case of meningitis/encephalitis associated with SARS-Coronavirus-2. *International Journal of Infectious Diseases*, *94*, 55–58. https://doi.org/10.1016/j.ijid.2020.03.062

Ozturk, T., Talo, M., Yildirim, E. A., Baloglu, U. B., Yildirim, O., & Rajendra Acharya, U. (2020). Automated detection of COVID-19 cases using deep neural networks with X-ray images. *Computers in Biology and Medicine*, *121*, 103792. https://doi.org/10.1016/j.compbiomed.2020.103792

Pettersen, E. F., Goddard, T. D., Huang, C. C., Meng, E. C., Couch, G. S., Croll, T. I., Morris, J. H., & Ferrin, T. E. (2021). UCSF ChimeraX: Structure visualization for researchers, educators, and developers. *Protein Science*, *30*(1), 70–82. https://doi.org/10.1002/pro.3943

Shah, A. U. M., Safri, S. N. A., Thevadas, R., Noordin, N. K., Rahman, A. A., Sekawi, Z., Ideris, A., & Sultan, M. T. H. (2020). COVID-19 outbreak in Malaysia: Actions taken by the Malaysian government. *International Journal of Infectious Diseases*, *97*, 108–116. https://doi.org/10.1016/j.ijid.2020.05.093

Tinanoff, N., Baez, R. J., Diaz Guillory, C., Donly, K. J., Feldens, C. A., McGrath, C., Phantumvanit, P., Pitts, N. B., Seow, W. K., Sharkov, N., Songpaisan, Y., & Twetman, S. (2019). Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: Global perspective. *International Journal of Paediatric Dentistry*, *29*(3), 238–248. https://doi.org/10.1111/ipd.12484

Tomeh, M., Hadianamrei, R., & Zhao, X. (2019). A Review of Curcumin and Its Derivatives as Anticancer Agents. *International Journal of Molecular Sciences*, *20*(5), 1033. https://doi.org/10.3390/ijms20051033

Ubando, A. T., Felix, C. B., & Chen, W.-H. (2020). Biorefineries in circular bioeconomy: A comprehensive review. *Bioresource Technology*, *299*, 122585. https://doi.org/10.1016/j.biortech.2019.122585

Wu, T., Hu, E., Xu, S., Chen, M., Guo, P., Dai, Z., Feng, T., Zhou, L., Tang, W., Zhan, L., Fu, X., Liu, S., Bo, X., & Yu, G. (2021). clusterProfiler 4.0: A universal enrichment tool for interpreting omics data. *The Innovation*, *2*(3), 100141. https://doi.org/10.1016/j.xinn.2021.100141

Xu, W., & Zammit, K. (2020). Applying Thematic Analysis to Education: A Hybrid Approach to Interpreting Data in Practitioner Research. *International Journal of Qualitative Methods*, *19*, 160940692091881. https://doi.org/10.1177/1609406920918810

Zhang, L., Chen, X. Q., Shao, R. W., Dai, J. Y., Cheng, Q., Castaldi, G., Galdi, V., & Cui, T. J. (2019). Breaking Reciprocity with Space-Time-Coding Digital Metasurfaces. *Advanced Materials*, *31*(41), 1904069. https://doi.org/10.1002/adma.201904069

Zheng, J., Wittouck, S., Salvetti, E., Franz, C. M. A. P., Harris, H. M. B., Mattarelli, P., O'Toole, P. W., Pot, B., Vandamme, P., Walter, J., Watanabe, K., Wuyts, S., Felis, G. E., Gänzle, M. G., & Lebeer, S. (2020). A taxonomic note on the genus Lactobacillus: Description of 23 novel genera, emended description of the genus Lactobacillus Beijerinck 1901, and union of Lactobacillaceae and Leuconostocaceae. *International Journal of Systematic and Evolutionary Microbiology*, *70*(4), 2782–2858. https://doi.org/10.1099/ijsem.0.004107