



Learning Space Transformation: An Innovation Design in the Computer Laboratory

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ABSTRACT

This research aims to develop an interior design plan for the computer laboratory at SMKN 1 North Luwu. The research methodology employed in this study is research and development (R&D). The research process consists of several steps, including analyzing potential issues and challenges, accomplished through an extensive review of existing literature and on-site field studies. Data is collected through methods, including observations, interviews, and documentation. The content of the design development encompasses several crucial aspects. First, it involves the creation of a design concept for the laboratory, which is then translated into detailed 2D working drawings and 3D perspective drawings. These design proposals are rigorously assessed and validated by experts and practitioners. The outcomes of this research effort include a comprehensive interior design plan tailored specifically for the computer laboratory at SMKN 1 North Luwu. This design plan is presented through detailed 2D drawings and 3D modeling using V-ray SketchUp 2020. The validation process of the design resulted in a score of 141 with a percentage of 97.9%, indicating that the product design is highly suitable as an exemplary model for managing the computer laboratory at SMKN 1 North Luwu, with a classification of "excellent."

INTRODUCTION

One of the critical components that significantly influences the organization and development of educational programs is the optimization of facilities and infrastructure in Information and Communication Technology (ICT) (Zhang et al., 2022). A crucial educational aid school requires is the Computer Laboratory (LabKom). A laboratory serves as a space or room to facilitate various learning activities, including experiments, teaching, training, and development, to enhance individuals' or groups' skills and reasoning abilities (Ruli As'ari, 2022; Widiastuti, 2020). Meanwhile, a school computer laboratory is a dedicated space for nurturing the technological skills of learners in the realm of information technology and communication (Toker and Baturay, 2021). Furthermore, the school computer laboratory can also support the learning process across various disciplines, including but not limited to ICT, natural sciences, social sciences, languages, and others.

The arrangement and development of educational facilities and infrastructure require deeper attention to remain relevant to the needs of development (Newby and Fisher, 2000). One effective approach to achieving this is through structured planning guided by proper management. Management, often referred to as "to manage," encompasses the concept of administration and governance, or in some cases, referred to as 'management.' More specifically, management pertains to leadership and the ability

to lead effectively. Hence, management is both a science and an art aimed at regulating the professionalism of individuals and others in the pursuit of predefined goals ([Hasibuan, 2017](#)). Consequently, management represents an organization, administration, and cultivation process encompassing various facets.

The steps to organize a laboratory are crucial in supporting the smoothness and success of learning ([Orrego, 1990](#)). It is essential to undertake planning by developing more effective designs to enhance the dynamism of space, making it more vibrant. Design refers to the architectural patterns, building motifs, initial concepts, frameworks, or building form, and the planning of the pattern of arrangements to be realized ([Paikun, 2021](#); [KBBI, 2017](#)). Thus, design management is the discipline that deals with an individual's efforts, using design skills to transform sketches into planning using resources such as tools, finances, or collaboration with others to achieve shared objectives. Design management is the science that teaches how to create new products, organize them, and market them ([Fernández-Mesa et al., 2013](#)).

Interior refers to the inner part of a building or space, the arrangement of furniture or decorations within the inner space of a building ([KBBI, 2017](#)). When defined, interior design is the initial concept of spatial planning within a structure to imbue it with value. Interior design is the activity of planning and designing a space within a building, considering its occupants' functions, aesthetics, and comfort ([Dwi, 2014](#)). In Islam, all activities, including interior or exterior design planning and arrangement, are evaluated within the framework of social good. It means that decisions must benefit society, alleviate difficulties, support aesthetic values, and uphold human dignity. Design management is directed towards creating spaces where people can seek refuge from all disturbances, designing comfortable and beautiful places, and designing spaces that facilitate human activities and problem-solving in life ([Elmualim and Gilder, 2014](#)). Therefore, the implications of incorporating design values into management are highly beneficial for humans' psychological and physiological well-being. Hence, a well-managed building with good design will also create good inhabitants.

State Vocational High School (SMKN) 1 North Luwu is one of the schools that possess and actively utilize computer laboratory facilities. This laboratory is utilized by students majoring in Computer and Network Engineering (TKJ) for ICT-related activities. In addition to supporting the teaching and learning process, the school's computer laboratory is also utilized for various other fields of study, including language and more. After conducting field observations, a problem was identified wherein the management lacked an understanding of interior design for the computer laboratory. Due to the limited computer laboratory space, which has resulted in insufficient room to accommodate needs, the management faces challenges in selecting furniture, arranging space-filling furniture, and mapping out the area, leading to disruptions in the flow of activities. Furthermore, insufficient lighting, ventilation, a lack of supporting furniture, and inappropriate and unserviceable furniture contribute to a perception of limited space within the room.

There is a need for the development of the computer laboratory to provide a design outcome that can serve as a reference for the school in reorganizing a more representative computer laboratory. This development aims to support independent learning mobility of students, enhance intensive communication among students, and facilitate multi-directional interaction. This research will discuss the planning and arrangement of computer laboratories, laboratory equipment standards, and various issues arising from improper management. This research aims to develop the concept of computer laboratory interior design following the needs of the management and visualize the concept's development outcome in the form of interior design plans, including two-dimensional working drawings and three-dimensional perspective drawings. This research hopes to address the existing issues within the computer laboratory through appropriate design efforts. By developing the interior design of the computer laboratory, students can more easily comprehend and engage in education, become more enthusiastic about developing their potential, and ultimately contribute to the creation of high-quality human resources in the future.

METHODS

The method employed in this research is research and development (R&D). Research and development is a research method used to produce a specific model and test the effectiveness of that model ([Sugiyono, 2016](#); [Zakariah et al., 2020](#)). The research was conducted at SMKN 1 North Luwu,

located on Tani Sawit Street, Tampalla Hamlet, Bone-bone Subdistrict, North Luwu Regency. The research was conducted twice. The first phase of the research took place for one month, from November to December 2021, while the second phase occurred from March to April 2022.

There were four subjects in this research: 1) Clara Zenicha Lioni, S.Ars., M.T., an expert in Design I, currently serving as a Quantity Supervisor at PT. Citrajasa Cipta Mandiri Palu. 2) Drs. H. Zaenal M.M., an expert in Design II and a materials expert, currently serving as the Secretary of the Education and Culture Office of North Luwu Regency. 3) The head of the computer laboratory at SMKN 1 North Luwu, Mr. Ahmad Haryono, S.Kom., as practitioner I. 4) Mr. Muh. Aswar Aswanda, Amd.Kom. serves as a staff and computer laboratory technician, practitioner II.

DISCUSSION

In this discussion, the computer laboratory interior design development results are presented in the form of two-dimensional working drawings and three-dimensional perspective drawings using the SketchUp 2020 application. The resulting development product can serve as an alternative example for managers and educational institutions to improve the management of computer laboratories. The research and development stages conducted to produce the computer laboratory interior design at SMKN 1 North Luwu are as follows:

Analysis of Potential and Issues

Preliminary studies, including literature review and field research, analyzed potential issues. The literature review involved studying literature related to interior design, such as the arrangement of space-filling furniture, spatial mapping, the application of interior design elements, and furniture size standards ([Lee et al., 2022](#)). Field research was conducted by observing the condition of computer laboratory management. Information regarding the issues faced by the management was gathered through interviews with the head of the computer laboratory and the computer laboratory manager.

The issues identified include limited laboratory space compared to the substantial need, suboptimal utilization of laboratory space, and unfulfilled procurement of supporting facilities. These issues can be related to the concept of laboratory design, which involves the planning and organizing laboratory space to optimize functionality, safety, and efficiency ([Yaneva, 2022](#)). Another issue encountered pertains to spatial mapping, which disrupts the flow of activities, inappropriate selection of space-filling furniture relative to room functions, disorderly arrangement of space-filling furniture, and a lack of security, safety, and ventilation facilities. These issues can be related to ergonomics, which involves the study of the relationship between people, their work, and their environment, aiming to improve well-being, safety, and performance ([Begg et al., 2021](#)). The potential identified is the existence of a computer laboratory for students with underutilized room conditions, yet there is an opportunity for empowerment and development.

Data Collection

Observation

Observation is conducted to obtain information by collecting data such as needs analysis of physical data and identifying the factors causing the issues, thus necessitating the development of a new model ([Johnson and Turner, 2003](#)). Additionally, material observation is carried out to determine the types of furniture materials that are safe, economical, and durable.

Interview

An interview is a meeting between two individuals to exchange information and ideas through questions and answers, thereby constructing meaning in a specific topic ([Johnson and Turner, 2003](#)). Interviews were conducted with Mr. Ahmad Haryono, S.Kom, the head of the computer laboratory, to obtain information about the condition and management of the computer laboratory. During the interview, the researcher analyzed the responses provided by the interviewee. If the information provided by the interviewee was insufficient or inadequate, the interview would be continued until complete information was obtained.

Document

The documents used in this research consist of written documents and images or photographs. Data obtained from the literature serves as material for developing the interior design of the computer laboratory.

Product Design

Design Creation

The next step is the creation of product design. The design for the development of the interior computer laboratory space includes:

1. Waiting Area and Lockers

The development of the waiting area will involve the design of a dedicated waiting space called the waiting room. The waiting room is designed to be as comfortable as possible by enhancing its existing facilities. It includes designing glass walls, a pair of black sofas, wooden cabinets for storing books or magazines, and installing an air conditioner to cool the room. The waiting room for the computer laboratory is designed with dimensions of approximately 255 x 261 cm. In addition to designing the waiting room, the author also designed a storage cabinet (locker) to store valuable items for guests and students. This locker is designed with 40 spacious drawers and is colored in blue and white to avoid monotony.

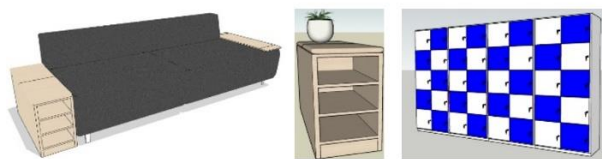


Figure 1. Furniture for the Waiting Area (Author's Design Process, 2023)

2. Administrative Area

The next development in the laboratory is to design the staff workspace, namely the administrative area. In the development of the administrative area, furniture will be designed, such as a glass cabinet made of a combination of MFC (Melamine Face Chipboard) due to its more economical price. Furthermore, an administrative desk will be designed, made of MFC, and the administrative desk will be designed with a glass display case for added practicality.

In addition to designing cost-effective furniture, the author has also designed a mini office for the staff to work and relax. The mini office is a glass-walled staff workspace with an approximate room size of 243 x 258 cm, equipped with facilities such as a computer, alarm, printer, telephone, CCTV, AC, fingerprint scanner, staff desk and chair, a first-aid kit box, and a dispenser.



Figure 2. Furniture for the Administrative Area (Author's Design Process, 2023)

3. Practice Area

The practical area is where learning occurs, with dimensions of approximately 800 x 631 cm. In the practical area, space-filling furniture is designed, such as student desks and chairs for computer

practice, an LCD projector complete with its LCD screen, teacher desks and chairs, whiteboards, and other supporting furniture. The computer desks are made of wood/Melamine Face Chipboard (MFC), while the practice chairs are made of plastic (see Figure 2). Teacher desks are made of MFC and come with drawers, while teacher chairs are selected with soft foam material, making them lighter, more comfortable, and equipped with wheels for easier movement and relocation.



Figure 3. Furniture for the Practical Area (Author's Design Process, 2023)

4. Zoning

The zoning design in the computer laboratory is carried out by dividing the workspace into three sections: the waiting area, which includes lockers and a waiting room; the administrative area, which includes a mini office; and the student practice area. As seen in Figure 4, number 1 indicates the waiting room, number 2 indicates the lockers, number 3 indicates the mini office, number 4 indicates the administrative center, and number 5 indicates the student practice area.

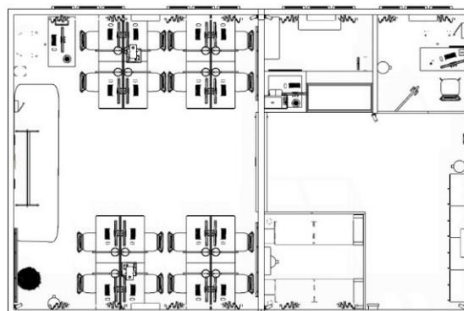


Figure 4. Development of Computer Lab Zoning (Author's Design Process, 2023)

5. Circulation

The circulation within the computer laboratory is designed to be as comfortable as possible. Activity circulation is directly established to be easily accessible with the shortest distance, and the number of turns is minimized. Activity circulation should be safe, with as few intersections as possible and avoiding narrow entrances. The entrance should be the same width as the distribution lanes for safety reasons. Activity circulation should have a logical sequence so that visitors are not surprised and it seems they are guided to know their direction. This guidance and explanation should be given through architectural language, which can be conveyed through the arrangement of space-filling furniture and the room's walls. The flow of activity circulation in the computer laboratory towards each work area can be seen in Figure 5, where the red arrows indicate the direct path to the waiting room, the yellow arrows indicate the path to the practice area, and the blue arrows indicate the path to the mini office or administrative area without any obstacles.

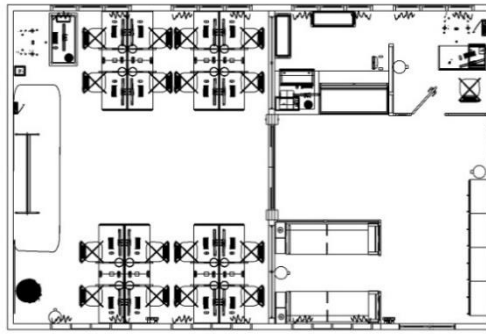


Figure 5. Activity Circulation in Work Area (Author's Design Process, 2023)

6. Lighting

The lighting in the computer laboratory to be used consists of direct lighting and artificial lighting. Direct lighting comes from direct sunlight through window openings and skylights. Meanwhile, the artificial lighting design utilizes 42 fluorescent lamps/tubular lamps, each with a power rating of 30 – 40W, to illuminate the room.

7. Ventilation

Natural ventilation is obtained by utilizing air humidity. Natural ventilation comes from skylight openings, placing indoor plants, and through sufficiently wide door or window openings. Meanwhile, artificial ventilation is obtained through mechanical equipment such as an Air Conditioner (AC). The ventilation design in the computer laboratory utilizes 6 AC units.



Figure 6. Air Conditioner ([3Dwarehouse.sketchup.com](https://3dwarehouse.sketchup.com), 2023)

8. Security, Safety, and Health System

The security system that has been designed includes adding CCTV cameras to monitor all activities in the computer laboratory 24 hours a day, every day. In addition to designing the security system, a safety system has been designed, such as adding alarms for warning purposes and fire extinguishers in case of unexpected accidents. The safety system can be found in each work area. Furthermore, the researcher has added trash bins in each area and a first-aid kit (P3K) as a health system within the computer laboratory. The P3K box is provided so that students or computer laboratory users do not need to go to the health center (UKS), which is far from the laboratory, to obtain medication if they are ill or injured.



Figure 7. Security, Safety, and Health System ([3Dwarehouse.sketchup.com](https://3dwarehouse.sketchup.com), 2023)

9. Wall Plans

The first designed wall is the one that separates the administrative area from the practice area. The partition wall is designed using raw materials such as bricks and cement. The wall has double doors

and is of the sliding door type. This partition wall also has two glass windows. In addition to designing the partition wall, glass walls are also designed for the waiting room and mini office. The glass walls are made of glass and iron as the raw materials or wood can be used as an alternative to iron. The waiting room glass wall has a single door, while the mini office glass wall has two doors. The partition wall and doors can be seen in Figures 13 and 16.



Figure 8. The Door to the Practical Area (3Dwarehouse.sketchup.com, 2023)

The result of the development of the interior design of the computer laboratory is in the form of two-dimensional working drawings created using SketchUp 2020. Previously, two-dimensional working drawings were used to design activity circulation and photographs of space-filling furniture. The following are images of the developed design of the computer laboratory at SMKN 1 Luwu Utara.

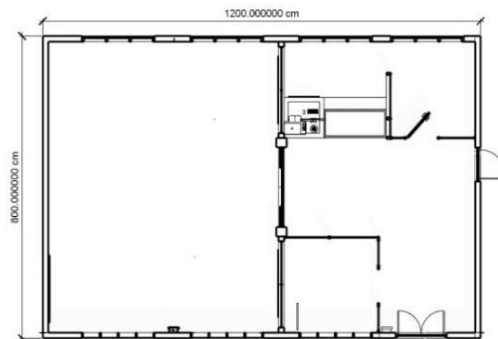


Figure 9. Layout of the Laboratory After Development (Author's Design Process, 2023)

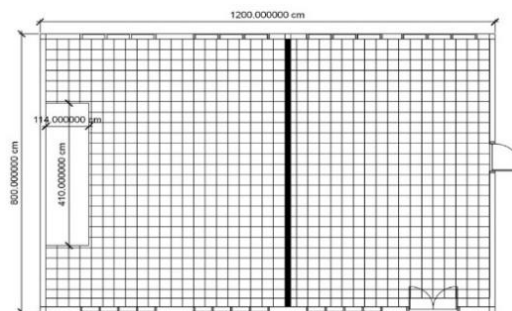


Figure 10. The Floor After Development (Author's Design Process, 2023)

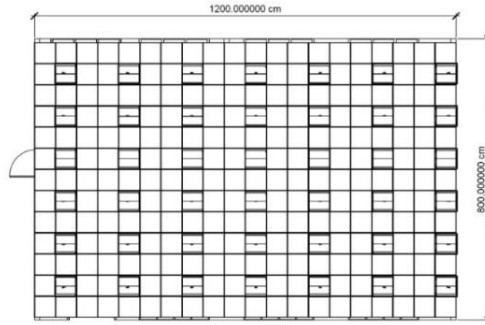


Figure 11. The Ceiling After Development (Author's Design Process, 2023)

The result of developing the computer laboratory's interior design includes two-dimensional and three-dimensional drawings. The three-dimensional design drawings are created using the SketchUp 2020 application. After completing the design, the rendering uses V-Ray to produce more realistic images. Here are the images of the developed interior design of the computer laboratory at SMKN 1 Luwu Utara:



Figure 12. The Laboratory as Seen from the North (Author's Design Process, 2023)

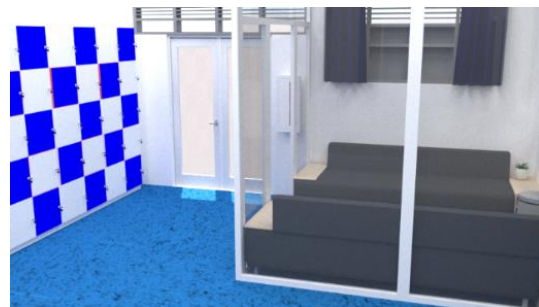


Figure 13. The Waiting Room and Locker (Author's Design Process, 2023)



Figure 14. The Laboratory as Seen from the South (Author's Design Process, 2023)



Figure 15. The Practice Area (Author's Design Process, 2023)



Figure 16. The Administrative Area (Author's Design Process, 2023)

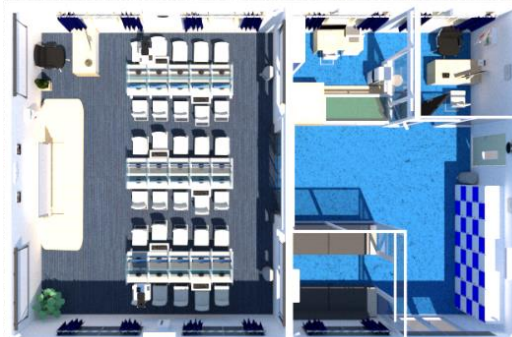


Figure 17. Top View of the Computer Laboratory (Author's Design Process, 2023)

Design Validation

Design Validation involves several design experts and school practitioners who frequently use the computer laboratory to provide assessments and feedback as recommendations for developing the computer laboratory's interior design. Design validation was conducted by design expert I, an architect, followed by expert II, who is competent in management science, and assessed by two practitioners from the computer laboratory. Here are the assessments from each validator:

1. Assessment by Design Expert I

The development of the computer laboratory interior design was first assessed by a competent architect, Mrs. Clara Zenicha Lioni S.Ars, M.T. Based on the assessment by design expert I, the overall development of the computer laboratory interior design meets the standard dimensions and can be considered as an alternative for computer laboratory management.

2. Assessment by Design Expert II

A management subject expert assessed the further development of the computer laboratory interior design, Mr. Drs. H. Zainal, M.M., who currently serves as the Secretary of the Department of Education and Culture of North Luwu Regency. Based on the assessment by Expert II, the overall computer laboratory interior design development is considered quite good as an alternative for computer laboratory management with the applied concept. Overall, the computer laboratory interior design development meets the requirements and can be applied to support the teaching and learning process.

3. Assessment by SMKN 1 Luwu Utara Practitioners

Two school practitioners conducted the final assessment. First, the assessment was carried out by Mr. Ahmad Haryono, S.Kom., the head of the computer laboratory. He evaluated that the design resulting from the development provides great comfort for users of the laboratory space, including students, teachers, and other school members. The furniture arrangement is neatly organized, making the space look comfortable despite limited space. The selection of furniture is in line with the management's needs. Muh. Aswar Aswanda conducted the assessment by the next practitioner. Both a staff member and a manager of the computer laboratory. According to him, the design is quite good, the chosen furniture for the computer laboratory suits the management's needs, and the circulation of activities is smooth.

Based on the assessments of the head of the computer laboratory and the laboratory manager, it can be concluded that the laboratory's design is suitable for implementation. The assessment aspects of this interior design development were adapted from components of design concept feasibility, harmony, aesthetics, achievability, and needs. This validation aimed to test the feasibility of obtaining relevant input related to the developed content. In addition to receiving input, a questionnaire was also administered. Below is the data obtained from the validation results.

Qualitative data were obtained through validation, resulting in an overall conclusion of the assessment of the computer laboratory design. The conclusion is that the development product is considered good and will serve as a reference for the arrangement or management of the SMKN 1 Luwu Utara computer laboratory. Quantitative data were obtained based on scoring the computer laboratory interior design development. The results of quantitative data testing are presented in percentage scores. Validation by expert: I received a total score of 36 with an average of 4 (perfect score). Validation by Expert II received a total score of 36, averaging 4. Validation by practitioner I received a total score of 34 with an average of 3.7, and validation by practitioner II received a score of 35 with an average of 3.8. In conclusion, the overall score totaled 141, resulting in a percentage of 97.9% with an excellent rating.

Table 1. Overall Assessment Results from Validation by Expert I, Expert II, and Two Practitioners

Aspect	Indicator	Total Score
The concept of computer laboratory design	Zoning division in inter-area mobility	16
	Multifunctional furniture design	15
Harmony	The suitability of space-filling furniture with room functions	6
	Lighting and ventilation	16
Necessity	Activity Circulation	16
	Security and Safety System	16
Attainment	Optimization of Space in the Interior Design of Computer Laboratories at SMKN 1 North Luwu	16
	Learning Activity Support	16
Beauty	Selection of Supporting Furniture and Additional Decor	14
TOTAL SCORE		141
PERCENTAGE		97,9%
CRITERIA		Excellent

CONCLUSION

The procedure for developing the interior design of the computer laboratory at SMKN 1 Luwu Utara begins with data collection through the observation, interview, and documentation phases. Next is the product design phase, which includes two development steps: conceptual design and drawing design. Conceptual design involves designing zoning into three work areas: waiting area, administrative area, and computer practice area. In addition to designing zoning, the author also designs space-filling furniture, mostly made of Melamine Face Chipboard (MFC) and wood, due to their quality and cost-effectiveness. The designed furniture is grouped and applied according to the activities and needs in each work area. Subsequently, design is done for circulation flow, lighting, ventilation, security system, safety system, health system, and the design of partition walls between areas. The next step is to create design drawings using Sketch Up 2020. After the new product is completed, the final step is validation. The overall validation results obtained a score of 141 with a percentage of 97.9%, concluding that the product is suitable to be used as an alternative example for managing the school's computer laboratory with an excellent rating.

The visualization of the interior development of the computer laboratory includes two-dimensional (2D) working drawings and three-dimensional (3D) perspective drawings. The 2D drawings include new space-filling furniture designs, wall and floor designs, new room layouts, circulation flow designs, and ceiling designs for lighting. Meanwhile, the 3D development results consist of realistic photos of the computer laboratory's interior after rendering using V-Ray. The physical form of the new product is organized and incorporated as part of this research thesis. The results of the development can be reproduced in various forms, such as photos, posters, books, or other documents, serving as an alternative example for developing computer laboratories at SMKN 1 Luwu Utara or other schools with a similar level.

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The authors declare no funding and conflicts of interest for this research.

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