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A strategy for reducing skills gap for the game development sector of the Indonesian creative industries

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A B S T R A C T

The Indonesian creative economy has been on the rise since 2015 when it has started being measured and prioritized by the government. Its contribution towards the Indonesian GDP has risen significantly as well. A small part of that creative sector is the video game industry and market. The video game global market will be worth USD 200 Billion in 2023. Indonesia currently is ranked 16th in terms of market size. Although having an enormous market opportunity, local video game producers only contribute 1%. Growth opportunities exist, however local game studios are facing the difficulty of recruiting quality game developers. Higher education institutions need to produce graduates having the knowledge, competences, and skills relevant for their work. This study is done to identify and prioritize attributes for the design of a university level program in game development that ensures employability in the sector. A qualitative thematic analysis is done in identifying the important factors for an academic program, followed by an analytical hierarchical process in determining the factors. Result of the study shows that a curriculum with internships in game studios, ensuring students are knowledgeable on the business models & video game market, having practitioners teach in the program, and creating a community of practice in the university is essential in producing quality graduates.

1. Introduction

The Indonesian creative economy has been formally recognized as an important contributor to the national economy and focus for development since the Ministry of Tourism and Creative Economy was established in 2011. The ministry then began developing blueprints for policies and legislations to help development of the creative sectors. In 2016, The Creative Economy Agency (BEKRAF) was established to advance and develop the creative economy sectors of the country. Since 2015, the Indonesian creative economy has increasingly contributed to the national GDP, reaching 7.16% or IDR 1,105 trillion (approximately USD 70 billion) in 2018. The creative economy which consists of 17 sub sectors has also been growing at least 5% annually (Setiawan, 2018). Of the 17 sub sectors under supported by BEKRAF, the 'Application and Game Developer' subsector has been growing steadily at more than 7% since 2016 (Setiawan, 2018). Furthermore, the subsector with two others, namely 'Film, Animation, and Video' and 'Music' is marked as priority sub sectors for development since they contribute to other sectors in the economy. BEKRAF prioritizes helping the Application and Game Developer subsector to increase their domestic market share. The video game market within Indonesia is worth USD 1.130 billion in 2018 and thus is ranked 17th in the world (Hudrasyah, Briantono, Fatima, & Rahadi, 2019). Furthermore, game market research company, Newzoo also indicated that the global video game market was USD 159 billion in 2020 and will reach USD 200 billion in 2023, making it very lucrative for export.

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According to the Indonesian Game Association (AGI), one of the hurdles for growth within the Indonesian video game industry is the lack of quality human resources. Higher education institutions (HEI) play an important role by providing intellectual support through work ready graduates and research (Harwiki & Malet, 2020). However, in the area of computing and information technology, many HEI in Indonesia are focused on producing graduates that are suited to work in corporate settings; its graduates lack the skills and competencies in more creative and multidisciplinary environments. This is due to the development of game development curriculum that usually evolve from traditional computer science curriculum (CS) and even utilize existing CS faculty; which leads to a disconnect between CS theory and practice and game development itself (Fachada & Códices, 2020). The business opportunity for entry and expansion in the video game market is huge, only 9.5% of the Indonesian video game market is served by local game developers in 2016, this is small compared to Vietnam whose market is 42% held by local developers (Hudrasyah et al., 2019). Furthermore, the global market is expanding as well. The video game industry can play a significant contributor to the Indonesian entertainment industry and impact other business models in digital ecosystems (Simon, 2018). There is a need for the programs in higher education to produce graduates that can readily work in the industry and other relevant industries in this digital age (Sousa & Wilks, 2018). This multidisciplinary environment requires creative workers that can acquire knowledge from within the company and from external parties, such as customers and game testers, in pursuing innovative outcomes (Yuana et al., 2021). Being adaptive to the external environment will also strengthen the company's organizational capability (Munizu & Riyadi, 2021).

This study is focused in formulating a strategy for improving the readiness of graduates in entering the game development industry by identifying critical elements of a game development curriculum in a higher education setting; namely what critical skills, competencies, and/or knowledge that are required for a game development program and its importance. Reducing the skills gap between education and industry is necessary in the field; higher education programs tend to equip students in generalized skills (Page et al., 2020).

2. Literature review

2.1 The influence of The Association for Computing Machinery in curriculum design

The Association for Computing Machinery (ACM) is an international society of educators, researchers, and professionals which had its roots in academia intended to advance the computing sciences, machinery, and information technology based in the United States. ACM published a 'Computing Curricula 2020 Report' (CC2020), their latest assessment of undergraduate CS curriculum and its relevance to the current stage of computing research and dynamics of the industry involving an international task force of 50 members (CC2020, 2020). Prior to CC2020, the latest guideline is the 'Computer Science Curricula 2013' (CS2013) which is still in adoption by universities globally. CC2020 which was less than one year old at the time this study was conducted has not yet resulted in new versions of curriculum guidelines by ACM (Joint Task Force on Computing Curricula & IEEE, 2013). In examining CS2013 and CC2020, a fundamental shift of perspective can be seen between the two documents. CC2020 emphasizes on the acquisition of competencies, whereas CS2013 focuses on knowledge-based learning needed for graduates in the field. Although CS2020 is not a guideline, but a framework for the implementation (standards) of a CS undergraduate curriculum, the change of perspective indicates how a future guideline would be produced. Table 1 lists the guiding principles of CS2013 and CC2020.

Inspection of the CS2013 guiding principles shows its emphasis in knowledge-based learning and knowledge areas that are essential in CS. Those knowledge areas are as follows: (1) Algorithm and Complexity, (2) Architecture and Organization, (3) Computational Science, (4) Discrete Structures, (5) Graphics and Visualizations, (6) Human Computer Interaction, (7) Information Assurance and Security, (8) Information Management, (9) Intelligent Systems, (10) Networking and Communications, (11) Operating Systems, (12) Platform-based Development, (13) Parallel Distributed Computing, (14) Programming Languages, (15) Software Development Fundamentals, (16) Software Engineering, (18) Systems Fundamentals, and (19) Social Issues and Professional Practice.

2.2 Game development curriculum

The knowledge areas covered under CS2013 provides a comprehensive foundation in developing competent CS graduates. However, the knowledge areas do not fit well in building the knowledge, skills, and competencies for a game development curriculum. The International Game Developers Association (IGDA) published a curriculum framework for game development that addresses the critical knowledge and skills needed for game developers (IGDA & others, 2003). IGDA's curriculum framework consists of nine core topic areas listed here (McCallum, Mishra, & Nowostawski, 2018): (1) Critical Game Studies, (2) Games and Society, (3) Game Design, (4) Game Programming, (5) Visual Design, (6) Audio Design, (7) Interactive Storytelling, (8) Game Production, and (9) Business of gaming.

The game development framework places a strong emphasis on the design and programming aspects of game development with the intention of providing the skills and qualifications for graduates entering the industry. It is important to note the fact that both CS2013 and IGDA curriculum frameworks are relevant to the study of game design and development; especially in considering the fact that many game development programs (especially in Indonesia) are retained under the

patronage of the CS study program due to government and/or accreditation regulations; as such, a game development program would be designed in having CS core subjects and the specific game development aspects of the curriculum would be incorporated as specialization, streaming, or minor subjects. Furthermore, the Indonesian government introduced new laws pushing the adoption of the Indonesian Qualification Framework (KKNI) in 2012, and pushed for universities to implement outcome-based education and acquisition of international accreditations for their programs. However, the development for creative workers needed for the creative industry is still low; although Indonesians by tradition and culture have a high potential for creativity (Setiawan, 2018). The direction set by CC2020 for designing and implementing curriculum is consistent to the expected transformations Indonesian universities should undergo. Academic literature about video games as an industry is growing but covers its value as entertainment and/or the specific development process (Engström, Berg Marklund, Backlund, & Toftedahl, 2018). A few covers the involved creative processes and hardly any covers the teaching and learning processes. The opportunity for growth in the industry in Indonesia is huge (Hidayat & Asmara, 2017); furthermore, a growing industry will attract foreign investments (Cohendet, Grandadam, Mehouachi, & Simon, 2018). The impetus for transforming game development programs for improving their relevance to the specifics of the developing video game industry in Indonesia is crucial and compelling.

3. Method

In addressing the research questions, a two-step process consists of a qualitative thematic analysis based on interviews and then followed by a quantitative analysis using the analytic hierarchy process (AHP). In the first stage of the study, interviews are conducted with five 'experts in the field' including academics having roles relevant to game development and/or curriculum development in general and with practitioners with senior management positions having the business and HR issues knowledge within the industry. Results from the interviews are then transcribed to electronic text for a qualitative thematic analysis. The NVivo 12 software application was used for this qualitative analysis. The objective of the analysis is to discover critical attributes/factors that should be present in a higher education curriculum for game development programs. The results will be used in the second phase to be reconstructed as a multicriteria problem. Constructing the multicriteria problem is done by creating a hierarchy of themes which are the results from phase one. The hierarchical structure can then be analyzed to obtain the measure of importance/priority of elements in the hierarchy towards a goal. AHP is a structured approach for analyzing complex decisions such that it provides a theory for measuring multilevel hierarchical structures using paired comparisons. As a method for decision making, AHP has been the most widely used and oldest (Bukhsh et al., 2020). Results of the AHP process is a prioritization based on the decisions of the experts (participants) through pairwise comparisons (Taherdoost, 2017; Saaty, 2008). The Expert Choice 11 application software was used for this analysis. The selection of 'experts' for the second stage is based on the penta helix framework. The construct, which is considered as an evolution of the triple helix construct, defines 'stakeholders' as a composition of five dimensions namely: academics, business, government, community, and media (Sudiana, Sule, Soemaryani, & Yunizar, 2020). The roles of university, industry, and government, as described in the triple helix model, is crucial for economic development since those three actors produce the knowledge flows necessary for innovation (Galvao et al. 2019). The penta helix extends the model to include community and media (Sudiana, Sule, Soemaryani, & Yunizar, 2020). Nine participants (experts) were interviewed whose occupations are from the five roles prescribed in the penta helix framework and have strong relevance to the video game industry in their respective occupations.

4. Results

After interviewing the five respondents, the result of a thematic analysis is described in Table 1. The table includes the theme, number times the theme was referred, and a short description of the theme based on the interviews.

Table 1
Resulting Themes

Theme	Refs	Description
Can work in diverse groups	46	Game developers work in groups with different backgrounds. The multidisciplinary creative process requires close collaboration between designers, programmers, testers, sound designers, and users who provide feedback about the game.
Have passion in game development	27	Becoming a game developer requires passion; not just the affection for playing video games.
Have the motivation	12	The game development process requires persistence. In many cases, ideas are generated bottom-up that starts with a team challenge to produce a simple game within a certain time. The best game will be selected as a concept to be developed.
Can learn independently	15	It will take two years for a fresh graduate in computer science in becoming a proficient game developer.
Have knowledge of the video game business and market	28	It is essential for a game developer to know various business models for revenue generation as they affect the game design. In-depth knowledge of the game market and its segmentations is also required since producing a playful product as a very customer centric process.
Have specific game programming skills	12	Game developers need specific programming competencies such as programming using game engines and mathematics intensive graphics programming.
Have good communication skills	18	Working in groups and intensive exchanges with customers (gamers) requires good communication skills.
Can use the tools and conduct practices that are standard in the industry	48	In addition to programming skills, game developers must have the ability to use software tools commonly used in the industry.

The themes are then mapped into criteria that will be used in creating the hierarchical model for AHP analysis as shown in Table 2. AHP analysis will determine the level of importance of the themes based on expert opinion.

Table 2
Theme to AHP criterion mapping

Theme	Criterion	Description of criterion	Selected
Can work in diverse groups	Multidisciplinary collaboration	Able to work together in multidisciplinary groups.	Yes
Have passion in game development	Engaging learning	Implement learning that engages students (Fredricks et al., 2010).	This theme is merged to 'Autonomy-supportive teaching'
Have the motivation	Autonomy-supportive teaching	Building intrinsic motivation through teaching using autonomy-supportive teaching. Lecturers teach with behaviors that encourage students to be actively involved in the learning process because they are considered valuable and interesting. (Furtak & Kunter, 2012). *This criterion also encompasses 'engaging learning'.*	Yes
Can learn independently	Problem based learning	Application of problem-based learning in the curriculum. This will generate creativity, problem solving skills, and motivation.	Yes
Have knowledge of the video game business and market	Video game business and market	Knowledge of various business models and markets in the industry.	Yes
Have specific game programming skills	Game technical competence	Game programming technical competence.	Yes
Have good communication skills	Communication	Ability to communicate well.	No
Can use the tools and conduct practices that are standard in the industry	Game technology and development processes	Learning content for mastering the technology and processes that have become standards in game development.	Yes

From the interviews, it can also be established that there are three influential actors that affect the criteria, namely: (1) the program, (2) community of practice (learning community), and (3) practitioners. Program as an actor refers to the owner and designer of an academic curriculum. Learning community is not specifically mentioned in the interview, however it is a form of implementing communities of practice; groups of individuals who study together for the same purpose and domain (Kim et al. 2018). The ecosystem in higher education institutions is an effective environment for implementing a learning community since the organization can oversee the process of sharing ideas and knowledge and developing resources and capabilities (Supena, IDarmuki, & Hariyadi, 2021). At the university level, learning communities can be used to harmonize teaching and learning, generate creativity, and stimulate interactivity and discussions relevant to game development. Learning communities have shown to impact positively by increasing motivation and confidence in students such that their personal identity in their future job is improved. That belief in the future creates a cycle that increases their motivation and confidence and thus their academic performance (Graham et al. 2013). Finally, practitioners refer to actors within industry whose work encompass various competences in game development. The three actors are also inserted in the decision matrix to identify their role priorities. Development of the AHP hierarchy is then continued to determine alternatives which are derived from the thematic analysis of interviews and are summarized in Table 3.

Table 3
Deriving alternatives from themes

Theme	References	Description
Competence based game development curriculum	71	Most CS programs in universities are designed to produce generalists. Game studios need human resources who have specific knowledge and competencies for game development such as: development using game engines, multidisciplinary collaborative work, and graphic programming. The curriculum needs to be specially designed to produce reliable and quality human resources.
Curriculum with internship in game studios	2	Internships in game studios will increase applicable knowledge on business and development processes in game studios.
Involving technical experts in teaching & learning	16	Bringing experts in the teaching & learning can improve the quality of learning. Students will benefit from the experience, knowledge, and the applicability of knowledge into practice.

After deriving the alternatives, the final hierarchical structure can be constructed for AHP analysis. Fig. 1 shows the final structure. After the criteria and objective has been set, quantitative analysis is done by comparing criteria pairwise. The pairwise comparison examines each criterion in the hierarchical structure and its relationship with the elements at the lower level. Experts' opinion is obtained for the comparison. An opinion is converted to a quantitative value using a scale of 1 to 9. Each expert in the study went through every comparison described in the hierarchical structure till the priority vector and consistency ratio (CR) is obtained.

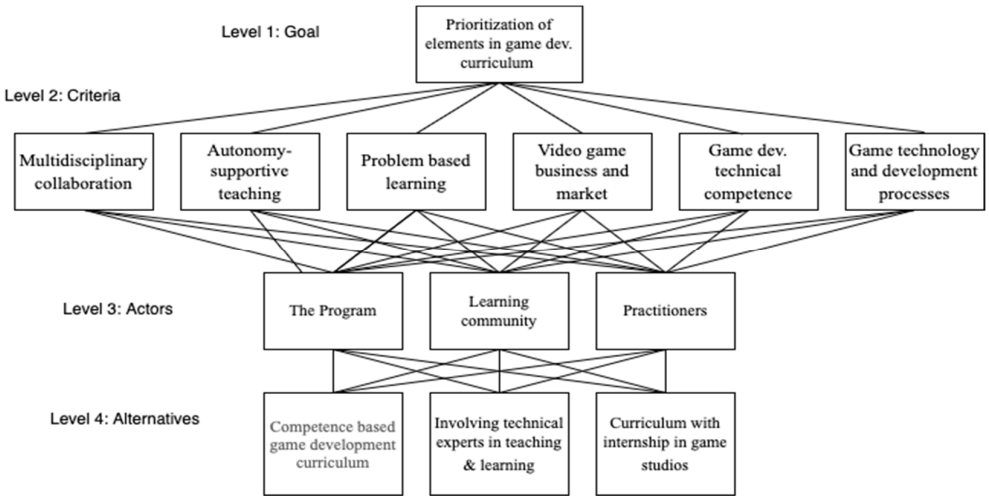

Fig. 1. Hierarchical structure

From the analysis, it is found that the criteria of ' Video game business and market ' gets top priority. This means that knowledge about video game business and market needs to be taught to students during their studies. Table 4 describes the resulting weights and priorities of the criteria level (level 2). Several respondents commented that many graduates pursuing a career in the video game industry do not understand the business models in the industry: specifically aspects of game design features for monetization. This understanding affects their perceptions, concepts, and motivations in the process of developing video games that they produce. Developing a game that is 'viable' for market acceptance is necessary for effective work and developing a stable business model (Tripathi et al., 2019). As an example, many of the new employees at game studios are passionate about developing games of a certain genre/type, unknowingly that its market acceptance may be low.

Table 2
Level 2 weights and priorities

Criteria	Weight	Priority
Video game business and market	0.260	1
Problem based learning	0.211	2
Multidisciplinary collaboration	0.170	3
Autonomy Supportive Teaching	0.154	4
Game development technical competence	0.112	5
Game technology and development processes	0.093	6

The hierarchical weighting carried out by all respondents is summed and sorted to get their priority. This analysis is carried out on the six elements of the criteria in the structure. Table 5 describes the results of the criteria analysis with respect to the actor level.

Table 3
Criteria analysis with respect to actor level

Criteria	The program	Learning comm.	Practitioners	Actor priority	Criteria priority
Video game business and market	0.145	0.18	**0.675**	Practitioners	1
Problem based learning	0.344	0.194	**0.463**	Practitioners	2
Multidisciplinary collaboration	0.159	**0.441**	0.4	Learning comm.	3
Autonomy Supportive Teaching	0.219	**0.448**	0.333	Learning comm.	4
Game development technical competence	0.283	**0.439**	0.278	Learning comm.	5
Game technology and development processes	0.223	0.36	**0.417**	Practitioners	6

Results show that experts believe that practitioners and the learning community have an important role in learning and preparing game developers to be work ready. Interestingly, the 'program' criterion which can be interpreted as the curriculum prepared by a university is not even a priority for any of the six criteria.

Furthermore, analysis at the alternatives level yields the goal of the overall AHP analysis. The results show that the alternative 'curriculum with apprenticeship in game studios' obtained the highest combination/priority score. The results are described in Table 6.

Table 6
Analysis of alternatives

Alternative	Vid. Game Biz & market	PBL	Multi. Colab.	Auto. Sup. Teaching	Game dev. Tech. comp.	Game tech. & Dev.	Total	Priority
Curr. w. apprenticeship.	0.090	0.089	0.080	0.073	0.041	0.036	**0.409**	**1**
Involving tech. experts	0.123	0.089	0.045	0.050	0.038	0.040	**0.385**	**2**
Competence based game dev. curriculum	0.040	0.046	0.025	0.036	0.039	0.019	**0.205**	**3**
Total	**0.253**	**0.224**	**0.150**	**0.159**	**0.118**	**0.095**	**0.999**	

Obtaining expert judgements from respondents can result in inconsistent scores. Saaty presented a way to measure consistency with a ratio known as the consistency ratio. An assessment is considered consistent if it has a CR < 0.10 (Shyam Prasad & Kousalya, 2017). In the process of a study, sometimes it is difficult to get the ideal CR. One way to increase CR is to tell the respondent that the assessment submitted is 'less' consistent, so that the respondent can give a more consistent answer. The reassessment will also be facilitated if the interviews are conducted simultaneously so that all respondents can reach a consensus when answering. This study was not conducted in unison due to the Covid-19 pandemic. Each respondent was interviewed through a video conferencing application (Zoom). In the face of these non-ideal conditions, ensuring an ideal CR is difficult during individual interviews and sometimes attempts to improve it are futile. This is supported by a study conducted by Adriana Agapie (2014) which succeeded in showing that only fifty percent of efforts to improve the value to increase CR will have an impact on the priority value moving towards (closer to) the true value (Agapie, 2014).

This study obtained a combined CR (combination of all respondents) of CR < 0.10 for the goals of the hierarchy, so that it can be declared consistent. The combined CR at the criterion level with respect to the actor level also meets the ideal CR. CR at each level of the hierarchy if averaged will get a value of 0.019 or 1.9% so that the results of the combination of respondents also can be considered consistent.

5. Discussion

5.1 Importance of practitioners in learning

From the criteria ‘video game business and market’, ‘problem-based learning’, and ‘game technology and development processes’, practitioners are found to be instrumental in contributing to learning. Experience and knowledge in the industry are considered essential for the enrichment of lessons. Results also show that 'practitioners' are also considered important in honing problem-solving skills; not the 'program'. One interpretation of these results is that 'problem-based learning' is important (second priority) but this ability needs to be developed by providing industry-relevant problems/challenges with the hope that students will enrich their knowledge and skills in the process of finding solutions. This means that practitioners are expected to help build the life skills needed to build a career in the video game industry. In other words, there is a gap between typical graduates and the ideal creative worker. This gap exists due to the disparity of the academic way of teaching software development and the reality of developing commercial games under real-life conditions within the industry (Engström et al., 2018).

5.2 Importance of learning communities

The criteria for 'autonomy supportive teaching', 'multidisciplinary collaboration', and ‘game development technical competence’ are influenced by the 'learning community' as the actor who contributes the most to learning. Higher education should be a manifestation of a learning community in developing creativity (Supena et al., 2021). Specifically, the learning community referred to in the AHP hierarchy is a specific learning community related to game development. A learning community is an environment that builds connectedness between individuals having a shared domain of interest. The interactions within the community will build discussions and activities between members. Furthermore, joint activities will build resources, experiences, stories, work tools, and ways to solve problems (Kim et al., 2018). Implementing learning communities also aids in developing students’ ability to learn and creativity (Wong, 2018). The results of the analysis explain that the learning community has an important role in building non-technical and technical skills. This role will help build creativity, problem solving skills, and the ability to build and maintain relationships with other members/students. It can also be seen that 'autonomy supportive teaching' (ASP), which was chosen as the third priority, requires the existence of a learning community to support the effectiveness of the ASP process. In addition to supporting ASP, it supports increasing motivation, passion and ultimately engagement in certain fields of knowledge. Game development is a collective effort that requires creativity and passion for the type of work (Whitson, 2019); the ASP model in learning will prepare students to work in entrepreneurial and creative work. The ASP teaching methodology shifts the role of the teacher as a powerful figure for learning. Students are considered as autonomous participants who actively participate (engage) and are responsible for the learning process. Teachers only have a role to provide direction and scaffolding for students (Ayllón, Alsina, & Colomer, 2019). Furthermore, by having a cohort of students facing similar problems/projects, an environment for collaborative learning can be created. The creative process requires iterations of brainstorming. A support system of

peers, teachers, and external experts will aid in the ensuring creative thinking (Ni et al. 2022). Students who are studying will need and seek support for the challenges faced in the learning process. The learning community fills that need. At the tertiary level, learning communities can be formed through student associations or clubs. At the program level, special clubs for video game development can be formed. For the course level, groupings can be formed so that group members can work together in the learning process.

The learning community also received the highest weight for the application of 'multidisciplinary learning' and 'game development technical competence'. The video game development process requires skills as diverse as computer programming, graphic design, animation creation, storyline development, graphic programming, and sound and music creation. Learning to develop video games requires good interpersonal skills so that the various components made by different individuals can be integrated into a complete video game. Multidisciplinary learning becomes a forum for students to gain experience in the development process that requires various skills and technologies/tools which must then be integrated. This process will result in many technical and non-technical (communication) challenges. As for the criteria for technical skills and competence in programming, it is important to build a learning community so that students can take advantage of the knowledge, means to overcome challenges, resources, and skills possessed by the community.

The results at the alternative level show that an internship at a game studio is a very important learning experience in the curriculum. Interestingly, the results are somewhat contradictory when compared with the results of the thematic analysis at the alternative level (Table 4). Interns at game studios were referenced only twice from five expert interviews. From the thematic analysis for the alternative level, 'competence-based game development curriculum' actually received the most references, i.e. 71 times. This shows that the opportunity for immersive learning in a real life setting is essential for the career. Structured academic programs are effective in equipping students with the essential hard competencies. However, challenges in the game development work are collaborative and distributed; students need to learn how to apply those technical skills within a network of organizational activities (Whitson, 2020).

5.3 Immersive learning through internship

The results in Table 6 also show the relationship between criteria and alternatives in detail. For the alternative 'curriculum with internship at a game studios', the most influential criteria are: (1) Video game business and market, (2) Problem based learning, (3) Multidisciplinary collaboration, and (4) Autonomy supportive teaching. The most influential criteria on the alternative of 'involving technical experts in learning' are: (1) Video game business and market, and (2) Problem based learning. Finally, the most influential criteria on the alternative 'Competence based game development curriculum' are: (1) Problem based learning, (2) Video game business and market, (3) Game development technical competence, and (4) Autonomy supportive teaching.

Internships in game studios show that students will gain an understanding of the game business and market and the process of how game features can be monetized. Video game business models vary widely, depending on the platform chosen by the game developer. Some of the common ways that developers do to generate revenues include direct selling, renting, free access but with advertising, free up to a certain level, free with purchases to get special features, and others. Through internships, students will gain insight and hands-on experience in implementing business models. From the educational aspect, students will be familiar with the process of finding solutions using the competencies and skills learned in the context of the business run by the game studio. Internships can increase passion, motivation, and engagement with the knowledge and competencies being studied.

5.4 Experts in teaching

The second alternative that is prioritized is 'involving technical experts in learning' which is strongly influenced by the criteria 'video game business and market' and 'problem-based learning'. This shows that universities need to involve 'experts' who are qualified as teaching staff/facilitators in the course. In the interview, it was also stated that the experts/experts listed in the hierarchy could be academics or practitioners. Thus, higher education institutions need to develop a collaborative relationship with the industry, This collaborative venture is essential in bringing research and experience based on real products (Kenwright, 2016). The results show that the program or curriculum needs to be specific to the competencies and industry issues related to game development. This means that the program cannot only produce generalists such as the cases for CS or information systems programs. Experts are also needed in learning so that cases or challenges given to students are relevant to specific skills and competencies in game development.

5.5 Curriculum for developing technical competency

In developing technical competencies for game development, priorities based on the results fall on: 'problem-based learning', 'game development technical competence', 'autonomy supportive teaching', and ' video game business and market'. This result shows that a game development curriculum requires a specific teaching and learning process. This

finding is important because it shows that independent learning should be accompanied by a passion for the game development process. Interestingly, it's importance eclipse technical skills and the mastery of technology. These finding is in line with an approach to reduce the skills gap between graduates and industry; higher education institutions improve graduate employability through (among other things) curriculum design, innovations in teaching and pedagogy, critical thinking, collaborative learning, as wells as career guidance and coaching (Okolie, Nwosu, & Mlanga, 2019). In addition, knowledge related to the game business and market is an important content for a curriculum that prioritizes game development competencies.

6. **Conclusion**

Based on the results of interviews, it was found that the processes of developing video game products are intensive and require knowledge, creativity, and innovation. The development process for independent games, unlike custom development, is usually based on existing games or is the result of a selection method involving teams of employees by pitching their prototypes. Based on expert opinions, industry know-how, real-life experience, and involvement of practitioners are necessary elements that need to be learned or must be implemented in the learning processes.

Higher education institutions in designing game development specific programs need to address the specific needs of the industry. This entails integrating topics of theory and practice related to computer science, mathematics, and art production (Ahn & Chung, 2019). From this study, students should also be taught the business side of the industry. Programs need to create a learning environment that instills motivation, passion, and an engaging teaching learning process. This environment needs to include the support for a game development learning community to flourish. Furthermore, having teachers/facilitators who are 'experts' in the relevant fields are essential in ensuring students gain the experience, knowledge, and competencies that reduces the learning curve they face in entering the job market. Game development needs a specialized curriculum that needs to focus on the life skills for the job; augmenting a generic computer science curriculum with game development specific courses will not be effective (Kenwright, 2016).

Game studios in Indonesia can also contribute to overcoming one of the problems they face, namely the scarcity of human resources who can work quickly. Businesses, as important actors in education, can have an important role in producing quality human resources. The results of the study also show that internships, the presence of practitioners, and the existence of a learning community are important features for a curriculum that prepares human resources for game development. This means that game studios need to open access so that more students can do internships, participate in the learning process in universities as experts and/or practitioners, and contribute to building an effective learning community. This is also relevant since most game studios in Indonesia are still in the startup phase and need to educate potential workers to the 'entrepreneurial' aspects of work in a startup (Wahyudi et al. 2021). Developing a close relationship between education institutions and industry players is not difficult. As seen in other countries where academic programs are still trying to catch-up with new career prospects such as game development; game company founders have a high level of willingness to engage in activities that will sustain the industry since it fulfills their creative calling (Lysova & Khapova, 2018). This will have a positive effect on increasing knowledge, passion, engagement, and specific competencies needed in fulfilling the scarcity of HR in the industry.

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