Learning Taxonomy-Based Education Game Design to Deploy Learning Objectives to Game Design: A Case Study of Leadership Education

Nur Budi Mulyono, Nur Arief Rahmatsyah Putranto, and Aria Bayu Pangestu

Abstract This chapter aims to propose educational games development to facilitate learning and maximizing joy during the learning process. The joy of learning through games has been tested in many subjects of teaching. Most of them show an improvement in the effectiveness of the learning process. However, developing a proper education game requires adequate analysis and methodology. The methodology in developing an education game combines expertise in specific knowledge areas regarding the learning objectives and content of the game, including rules, rewards, challenges, difficulty, and environment. Despite the growing research related to leadership, the application of experiential learning for leadership education to corporate participants is currently limited. This chapter presents the methodology of development and implementation of an educational game "Chaotic Company" to a corporate participant who has learning objectives of execution focus, concern for order, adaptability, and organization awareness. The developing process starts with analyzing the knowledge area and determining the learning objectives and delivery strategies. These analyses relate to the concept of the game environment, elements of game used, and the levels of the game. The result revealed that the game's case, "Chaotic Company (CC)," has direct relevance in increasing understanding and analysis of the learning objectives.

Keywords Corporate Participant · Development Methodologies · Education Game · Leadership · Learning Objectives

N. B. Mulyono (✉) · N. A. R. Putranto · A. B. Pangestu
School of Business and Management, Bandung Institute of Technology, Bandung, Indonesia
e-mail: nurbudi@sbm-itb.ac.id; nur.arief@sbm-itb.ac.id; aria.bayu@sbm-itb.ac.id

1   Introduction

Application of games is one of the innovative methods to inhibit active learning and experiential learning and excite student interest, participation, and concentration. A game is any activity involving a set of rules and challenges where players compete using their knowledge and skills to win a specified goal (Rowles and Brigham 2005). In gaming, students are required to be active learning participants, considering their strengths and weaknesses to present their performance, and reflect future goals accordingly (Kolb 2014). The main benefit of gaming as an educational strategy is that single activity covers a large quantity of learning material (Boctor 2013).

Game-based learning, named as serious education game, refers to a methodology that applies game principles to promote students' learning while gaining positive cognitive and affective experience in a learning process (Michael and Chen 2006). Game-based learning can enhance the social skills of learning participants and improve their skills in understanding, analyzing, and solving real-life problems (Kirikkaya et al. 2010). Students learn actively through game-based learning, gain greater interest, and leave a more profound impression on the learned materials than using conventional methods (Papastergiou 2009).

In the past, studies on game-based learning focused on the digital and non-digital type of game. Games such as board games, card games, and digital games began to be widely used in the learning process since they provide challenges and fun in the learning process without sacrificing the objectives of learning. A digital game can enhance learning motivation and trigger positive emotions among students; however, a digital game has difficulty in providing face-to-face interaction that board and card games can provide (Liu and Chen 2013). The face-to-face interaction in learning is vital since it exposes the student to human emotional expressions, physical actions, and spoken tones (Billinghurst and Kato 2002). Using the educational card and board games, the student may elevate the interpersonal interaction directly between facilitator and students as well as among them to a degree unreached by the digital aspects (sound, audio, and visual effects) of digital games.

The participants of the game-based learning are not only focused on children in elementary education but also can be used for students in higher education as well as an experienced person of industry practitioners. While Ariffin et al. (2014) evaluate the effectiveness of game-based learning in higher education, Strickland and Kaylor (2016) describe the essential foundation theory for the integration of game-based learning in nursing education and discuss crucial components related to the implementation of one educational game in nursing.

Choosing the appropriate games, in terms of learning objectives, target audience, and the age of learners, is a challenge in itself. Improper games design may lead to the reverse impact of the learning objectives and may not attract the interest of the student. There is some developed educational game in different domains such as entrepreneurship (Guardia et al. 2014), nursing (Strickland and Kaylor 2016), circular economy (Whalen et al. 2018), and leadership (Sousa and Rocha 2019). Most of the approaches in the development of educational games emphasize that the

building blocks of an educational game are from learning materials of domain knowledge. Hence, the development frameworks rely on the relationship between learning materials in domain knowledge and design of the game. Ahmad et al. (2015) present survey data of the different design frameworks used for educational games and analyze them against several criteria. The development frameworks that rely on learning materials may become ineffective since the development process does not seamlessly map between learning materials, the hierarchy of learning objectives, and game design. This situation might occur in domain knowledge, including the leadership domain.

Dobbins and Pettman (1997) mention that leadership is a unique ability to motivate other people to work on achieving common goals and make people present an extraordinary performance. Nurturing skills of a person in the context of leadership education is vital since the leadership process is an essential factor for determining success in the career path. However, leadership is a challenging domain to teach in a traditional education system since the delivery of leadership theory is not enough to nurture leadership skills, but it needs to be followed by the process of cultivating leadership skills. Therefore, we aim to develop a framework for educational game development in the leadership domain, considering the mapping between learning objectives, learning materials, and game design. In our proposed framework, we develop a proof of concept of educational game for leadership, Chaotic Company, to demonstrate the usefulness of our proposed framework.

The remainder of this chapter is organized as follows. Section 2 presents reviews about recent literature related to educational games, leadership, and learning taxonomy. The methodology of game development is presented in Sect. 3. Furthermore, Sect. 4 discusses the result and implementation and succeeds by discussion in Sect. 5. Lastly, Sect. 6 presents the conclusion of this research and possible future direction.

2 Related Work

2.1 Educational Game

The educational game methodology has an advantage over traditional education where the learning process is designed to solve practical problems, and emergence is situated in the simulated environment. The typical way of developing educational games is based on learning models, pedagogical components, age and gender, and game design aspects (Baranowski et al. 2008; Gress et al. 2010; Hirumi and Stapleton 2009; Mikropoulos and Natsis 2011). The learning models in educational games are constructivism, behaviorism, cognitivism, and humanism. Educational game pedagogy is different from the traditional education approach that has a paradigm focused on the teacher as the agent of the action and less as a facilitator of learning (Sousa and Rocha 2019). Van Staalduinen and de Freitas (2010) listed

12 elements of the game from the literature and grouped those elements into four dimensions, such as learner specific, pedagogy, representation, and context.

The three perspectives of the learning process in educational game theory are the learning process driven by game technologies (Gee 2003; Prensky 2003), the educational game development process, and pedagogies. Here, the learning process occurs not only within a game but also through several activities that are complementary to the game. As mentioned in the last perspective, the educational game is pedagogical innovation driven by the principles of game design. Hence, the learning process is using game mechanisms and components are role-playing, competition, achievement, and reward system (Kapp 2012).

2.2 Leadership

Leadership relates to the skills and degree of influence of another person to move in the direction of goals, make decisions, and do things according to the guideline (Kets De Vries and Florent-Treacy 2002). Leaders adopt different leadership styles, depending on the environment and situation, not only choosing a dictatorial style (Zaccaro et al. 2001). Lewin et al. (1939) mentioned that there are three leadership styles based on decision timing: autocratic leaders, democratic leaders, and Laissez-faire.

Autocratic leaders make decisions without discussing with their team members. These leaders might appropriate when decisions need to be made in a short time, and agreement of the team is not necessary for an outcome. On the other hand, democratic leaders include team members in the decision-making process, but they make the final decision. Lastly, in laissez-faire style or autonomy, leaders give their team members freedom to do their work and to set their deadlines. Leaders provide support with resources and advice if needed, but they do not get involved.

Bass (1990) identified two types of leadership based on approach to team members: transactional and transformational. Transactional leaders grow in situations of low complexity, but transformational leaders emerge in cases of high complexity. In transactional leadership, the followers get a reward for meeting the performance targets. On the other hand, in transformational leadership, the leader develops a vision, respect, and trust and exhibits charisma. Also, the leaders pay personal attention, provide stimulation, and challenge their followers with new ideas and approaches.

2.3 Learning Taxonomy

Bloom's taxonomy is represented in higher education's objectives across the disciplines including science and engineering disciplines (Conlon 2008; Pappas 2004), as a creative method of teaching problem-solving in engineering design (Striegel and

Rover 2002). Bloom's taxonomy is a method to classify learning activities as a hierarchy in terms of cognitive difficulty (Pappas et al. 2013), where the higher levels require more sophisticated cognitive thinking skills. As we move upward to the hierarchy, the learning activities require more advanced thinking skills. The thinking processes characterize each level, as follows: knowledge, comprehension, application, analysis, synthesis, and evaluation.

3 Game Development

We propose an alternative design framework for educational game development addressing the mapping issue of learning taxonomy and game design, as illustrated in Fig. 1. In game design, the first thing to determine is the purpose of making the game. Without a clear use, the process of making the game will become unfocused. As a game designed for leadership education, Chaotic Company aims to develop the skills of its players related to leadership in business and management contexts. In
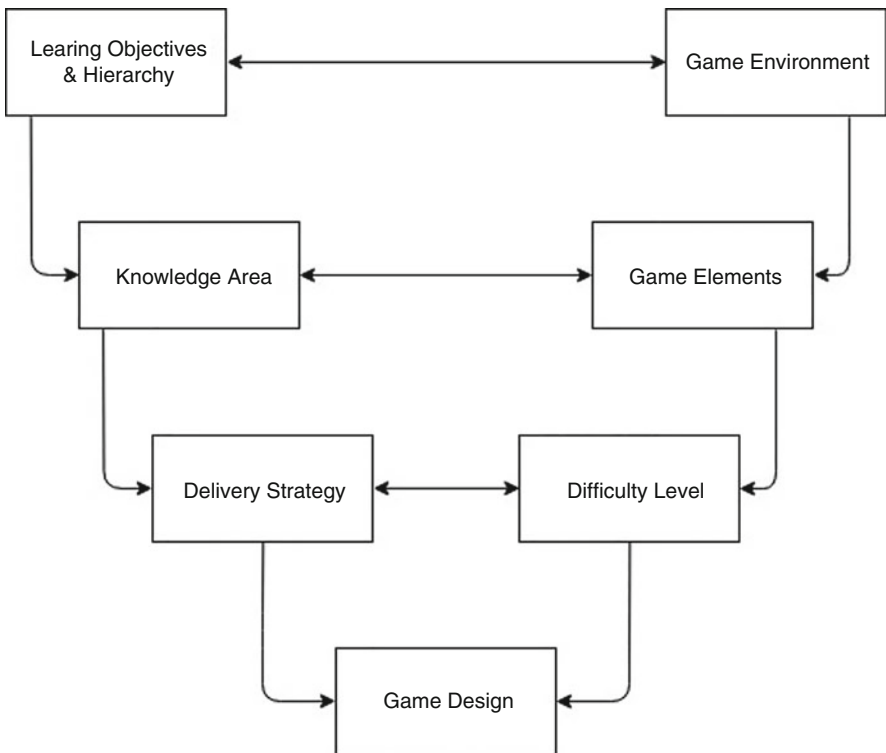

Fig. 1 Proposed educational game development framework. (Source: authors own study)

this case, the selected leadership skills are execution focus, concern for order, adaptability, and organization awareness.

Execution focus is a skill to focus on the tasks and responsibilities that are owned by the positions they have. This skill is vital for a leader because the leader must be a role model for his/her subordinates. If a leader cannot demonstrate his performance on this skill, it will impact on employee motivation. Concern for an order is a skill to know the relationship between a division and other divisions. By understanding the relationship between the divisions, a leader can determine the appropriate task for each division to achieve an effective and efficient system. Adaptability is the ability to adjust to changes that occur. A leader must be able to formulate appropriate strategies in responding to changes to survive or even bring the organization to a better condition. Organization awareness is the ability of a person to be aware of the status of the organization and what things happen therein. An ignorant leader can impact on the quality of the strategy formulation since the basis of strategy development is not merely on actual conditions and existing information. To avoid this, a leader must have a good organization awareness.

The next thing to note after setting a goal is the game environment. As games that bring the business and management context, CC must be created to simulate the business and management processes of a company. Besides, it is necessary to determine the nature of the game, whether it will be competitive, collaborative, or both. To achieve the learning objectives, the CC is designed to be played collaboratively because the leadership skill development process will be more effective when based on the collaborative process.

The next stage is the process of determining the gameplay of the game that includes rules, rewards/punishments, and challenges. The development of the gameplay relies on the game environment and considering the learning objectives. Based on this, the elements that must exist in the Chaotic Company are as follows: First, the rules that accommodate the collaborative where the players must have a common goal and rewards/punishments given will impact the entire players. Second, the role of the players should be able to accommodate the learning objectives (in this case, execution focus and concern for order) as well as business and management context. Third, the challenge given should be able to facilitate adaptability and also organization awareness so that the strategy made by the players in playing this game should pay attention to the changes and situation of the game today.

After determining the gameplay, the next thing to do is create scenarios in playing a game. Scenario development becomes essential to adjust to the level of difficulty since players may have different backgrounds (e.g., experience in gameplay, age, and even work experience). Various scenarios can have setup, gameplay, and even different purposes. Also, scenarios aim to vary the difficulty level of the games (e.g., to provide a higher level of difficulty, create more complicated situations or scenarios with more difficult challenges). CC is a game designed for leadership education, so the scenarios created must take into account the leadership experience of the players. The more players' leadership experience, the more complicated the scenario will be. In this case, CC can be played using three different scenarios for players with low, medium, and high leadership experience levels.

4   Result and Implementation

4.1   Gameplay

One of the characteristics of Chaotic Company is collaborative design. There will be five players who play this game, each with their unique role: "R&D manager," "finance manager," "production manager," "marketing manager," and "HR manager." Each player has employees, capital, and products in the inventory, known as WIP (work in process), at the beginning of the game. They also have three demand cards that represent the demand for the company. Figure 2 illustrates the layout of the board game Chaotic Company.

The game starts by drawing a new demand card. After players observe the demand cards, the first turn will be of the player who acts as "R&D manager." The player will decide what product to produce and the quantity based on the number of employees in that division (each employee will have specific lead time and a maximum capacity for each product). After the "R&D manager" finishes his or her turn, the next turn will be of the "finance manager" who should decide the product and its quantity to produce. The product will be coming from its inventory (WIP). When finished, the next turn will be of the "production manager" who decides the product and its number to be produced. A bit different from the "R&D manager" and "finance manager," there will be production costs for each product that division production made. When "production manager" ends his or her turn, the next turn is of the "marketing manager" who will sell the product (remember that similar to the previous managers, the product produced will be limited by the number of product in WIP, number of employees, a maximum capacity of each employee, and lead time). Finally, the "HR manager" will decide whether to hire new employees or to train the employee to the next level (the number of employees possible to hire and training depends on the number of employees in HR division).

Fig. 2 Chaotic Company board game. (Source: Mulyono 2017)

HR division can also retain or training HR employees. If an employee decided to take training, the employees stop doing any work. The hiring and training process takes cost and lead time.

After players finish their turn, they will draw an event card (one event card for each round). The event card will affect the process that happens in that round (e.g., there is an event card that gives additional lead time or reduces lead time). Then, to close the round, all players must count the number of a product that remains in their WIP and pays inventory cost. The game then moves to the next round.

In each round, all players will do the same thing. However, starting the second round, at the beginning of the turn, each player will conduct these activities: (1) Reduces lead time for each process by one period. (2) Decide if they will make their employees do overtime (overtime will reduce another one lead time, but it needs cost). Overtime can only be done one time only for each employee in each round. (3) Move the product that already finishes the process to the next division. The finished product is placed in WIP except for the marketing division, who will sell the product based on demand and receive the money. Since the players are not allowed to borrow money, they lose if they cannot pay the inventory cost at the end of each round. The group who wins the game will be the group that has the most money at the end of the game.

4.2 Implementation

The game needs to be played in training to measure effectivity. Chaotic Company has been used in training held by one of the state-owned companies in Indonesia. The trainees can be divided into three levels from the supervisor level to the manager level. To accommodate the different needs, the development of the game scenario is necessary for each managerial level. For the lowest managerial level, the rule uses the default rule, while for the middle management, there will be an additional rule in which for employees who do nothing, the player needs to pay a penalty cost. In the highest level of management, a further condition of defect product is established. The player needs to roll dice when transferring a product to the next division or sell it to a customer. If they roll 1 or 2, one product will defect and need to be discarded from the game.

In this training, the Chaotic Company is played by three different groups who compete with each other to get the most money. The time to play the Chaotic Company is 2 h, which consists of 10 min to explain the game, 20 min to trial the game, and 90 min to play the game. The game usually ends after 6–9 rounds. After the game is finished, the trainees are asked about the lesson learned about the game.

5   Discussion

Our research presents the thinking process of the board game development as a tool of learning. In designing a board game for the teaching and learning process, it is essential to focus not only on the learning content and goals but also on the game mechanics as well as accommodating the gamers' needs. In designing a game board for training, it is essential to apply the ARCS model developed by John Keller in 1987. ARCS model explains that excellent learning and teaching tools need to invoke four aspects of a learner, which are as follows: attention, relevance, confidence, and satisfaction (Li and Keller 2018). The board game designed as a tool of learning also needs to be designed to invoking these four aspects. Chaotic Company board game is designed to try to invoking those four aspects from a learner who is playing this game. Event cards and an element of surprises designed in the game are created to invoke the attention of the learner. As for the relevance, Chaotic Company is intended to use a real division name and real product name from the state-owned company to give a sense of simulation of the actual situation. The difficulty of the game is designed to be challenging while still manageable to beat. This controlled difficulty is intended to invoke the confidence of the player. Moreover, giving rewards and competition between groups will invoke a sense of satisfaction upon finishing the game.

As creating a board game has a lot more considered factors and has higher complexity, a question arises: Whether the impact of a board game as a learning tool is higher than other methods? To answer this question, the researcher tries to get feedback from the client regarding the effectiveness of using board games in teaching in the state-owned company, compared to other methods usually used there (Lecture, Class Activity, Group assignment). The result is acquired from 5 different batches of the game, showing that all batches have a high satisfaction rate of the training. The client mentioned that the learner shows a high level of engagement in training and a high level of happiness compared to other methods ever held for the same purpose.

This testimonial from the client gives the researcher better confidence to say that even though creating a board game is more complicated than designing other training tools, it has a more significant impact and a higher level of engagement in learning for the target learner. However, to achieve this, a specific method of creation is required. All the aspects of the board game need to be carefully tested to ensure its balance and maximize its effectiveness. This research demonstrates the Chaotic Company board game in teaching leadership; this research only showing one specific learning topic using one particular game. The whole effectiveness of the game board in teaching and learning still needs further studies.

6 Conclusion

We have successfully developed an educational game Chaotic Company using a strategy that combines learning objective and taxonomy, domain knowledge, and game design. The game described in the chapter allows learning participants to understand and implement learning objectives of execution Focus, concern for order, adaptability, and organization awareness. This game uses a simple or more complex scenario depending on the managerial responsibility in the company, analyzing the situation of the company, making decisions to improve company competitiveness. During gameplay, students learn effectively about the management role of their companies, receiving the essential external and internal information, changing policy, and responding events. In this regard, students can learn materials in depth to improve their educational performances while enjoying the game.

Leadership is considered valuable to the success of the company. In the context of strategic management, the complexity of the business environment, policy changing, and technological advancement are main forces of uncertainty, and educational games have shown a significant contribution to leadership skills development. The new educational board game we have developed with our framework has shown satisfactory results in achieving learning objectives and entertaining students.

References

Ahmad, M., Rahim, L., & Izza Arshad, N. (2015). An analysis of educational games design frameworks from software engineering perspective. *Journal of Information and Communication Technology, 14*, 123–151.

Ariffin, M. M., Oxley, A., & Sulaiman, S. (2014). Evaluating game-based learning effectiveness in higher education. *Procedia Social and Behavioral Science, 123*, 20–27.

Baranowski, T., Buday, R., Thompson, D. I., & Baranowski, J. (2008). Playing for real: video games and stories for health-related behavior change. *American Journal of Preventive Medicine, 34*(1), 74–82.

Bass, B. M. (1990). From transactional to transformational leadership: Learning to share the vision. *Organizational Dynamics, 18*(3), 19–31.

Billinghurst, M., & Kato, H. (2002). How the virtual inspires the real. *Communications of the ACM, 45*(7), 64–70.

Boctor, L. (2013). Active-learning strategies: The use of a game to reinforce learning in nursing education. A case study. *Nurse Education in Practice, 13*(2), 96–100.

Conlon, E. (2008). The new engineer: Between employability and social responsibility. *European Journal of Engineering Education, 33*(2), 151–159.

Dobbins, R., & Pettman, B. O. (1997). Self-development: The nine basic skills for business success. *Journal of Management Development, 16*(8), 521.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York, NY: Palgrave Macmillan.

Gress, C. L., Fior, M., Hadwin, A. F., & Winne, P. H. (2010). Measurement and assessment in computer-supported collaborative learning. *Computers in Human Behavior, 26*(5), 806–814.

Guardia, D. L., Gentile, M., Grande, V. D., Ottaviano, S., & Allegra, M. (2014). A game based learning model for entrepreneurship education. *Procedia Social and Behavioral Science, 141*, 195–199.

Hirumi, A., & Stapleton, C. (2009). Applying pedagogy during game development to enhance game-based learning. In C. T. Miller (Ed.), *Games: Purpose and potential in education* (pp. 127–162). Boston: Springer.

Kapp, K. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. San Francisco, CA: Pfeiffer.

Kets De Vries, M., & Florent-Treacy, E. (2002). Global leadership from A to Z: Creating high commitment organizations. *Organizational Dynamics, 30*(4), 295–309.

Kirikkaya, E. B., Iseri, S., & Vurkaya, G. (2010). A board game about space and solar system for primary school students. *Turkish Online Journal of Education Technology, 9*(2), 1–13.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press.

Lewin, K., Lippit, R., & White, R. K. (1939). Patterns of aggressive behavior in experimentally created social climates. *Journal of Social Psychology, 10*, 271–301.

Li, K., & Keller, J. M. (2018). Use of the ARCS model in education: A literature review. *Computers & Education, 122*, 54–62.

Liu, E. Z. F., & Chen, P.-K. (2013). The effect of game-based learning on students' learning performance in science learning—A case of "Conveyance Go". *Procedia Social and Behavioral Science, 103*, 1044–1051.

Michael, D. R., & Chen, S. L. (2006). *Serious games: Game that educate, train, and inform* [e-book]. Boston: Thomson Course Technology. Retrieved December 2, 2019, from https://dl. acm.org/.

Mikropoulos, T. A., & Natsis, A. (2011). Educational virtual environments: A ten-year review of empirical research (1999–2009). *Computers & Education, 56*(3), 769–780.

Mulyono, N. M. (2017). *Chaotic company board game*. [photograph] (Nur Budi Mulyono's own private collection).

Papastergiou, M. (2009). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers and Education, 52*(1), 1–12.

Pappas, E., Pierrakos, O., & Nagel, R. (2013). Using Bloom's taxonomy to teach sustainability in multiple contexts. *Journal of Cleaner Production, 48*, 54–64.

Pappas, E. C. (2004, April 4–6). Teaching thinking and problem solving in the university curriculum: A rationale. In *Proceedings of the American Society for Engineering Education (ASEE) Southeastern Section Meeting*. Auburn, Alabama, USA, Session 209. Washington, DC: ASEE.

Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment (CIE), 1*(1), 21–21.

Rowles, C. J., & Brigham, C. (2005). Strategies to promote critical thinking and active learning. *Teaching in Nursing: A Guide for Faculty, 2*, 283–315.

Sousa, M. J., & Rocha, A. (2019). Leadership styles and skills developed through game-based learning. *Journal of Business Research, 94*, 360–366.

Strickland, H. P., & Kaylor, S. K. (2016). Bringing your a game: Educational gaming for student success. *Nurse Education Today., 40*, 101–103.

Striegel, A., & Rover, D. (2002, November 6–9). Problem-based learning in an introductory computer engineering course. In *Proceedings of the Frontiers in Education (FIE) National Conference*, Session 196. Boston: IEEE.

van Staalduinen, J.-P., & de Freitas, S. (2010). Chapter 3. A game-based learning framework: Linking game design and learning outcomes. In M. S. Khine (Ed.), *Learning to play: Exploring the future of education with video games*. New York: Peter Lang Publishers.

Whalen, K. A., Berlin, C., Ekberg, J., Barletta, I., & Hammersberg, P. (2018). 'All they do is win': Lessons learned from use of a serious game for circular economy education. *Resources, Conservation and Recycling, 135*, 335–345.

Zaccaro, S. J., Rittman, A. L., & Marks, M. A. (2001). Team leadership. *The Leadership Quarterly, 12*(4), 451–483.