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PRELIMINARY ANALYSIS ON ENTERTAINING EDUCATIONAL CONTENT FOR LEARNERS WITH AUTISM SPECTRUM DISORDER

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Abstract – *This paper reports on an ongoing study regarding the needs of autism spectrum disorder learners for entertaining learning materials. Previous researchers have introduced a number of assistive technologies, but the use of assistive technologies is problematic for students with autism spectrum disorder. The lack of entertaining learning material for autism spectrum disorder students may be one of the reasons. Therefore, this study proposed student–centred learning and self–paced learning approaches to better help autism spectrum disorder students for learning. The methods of fieldwork and semi-structured interviews were utilized to investigate the needs of autism spectrum disorder learners for entertaining learning materials. During the fieldwork, the favorite or main leisure activities at home of the participants were collected. Semi-structured interviews were conducted with teachers in special schools to investigate students' needs for entertaining learning materials. The study results indicated that there are very few entertaining learning materials developed specifically for learners with autism spectrum disorder, but the need is urgent.*

Keywords: autism spectrum disorder, courseware, entertaining, mobile devices.

I. INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by social and communication deficits, including limited repetitive and sensory-motor behaviors [1]. Paul et al. [2] emphasized that students with special needs will demonstrate a deep personal understanding of how their strengths and needs affect their lives and provide insightful information if they have the opportunity. In short, people with special needs (e.g., ASD students) can learn with learning support. However, because ASD students lack basic cognitive and learning skills, their knowledge exploration process can be difficult [3–6]. Educating ASD students is not a new issue, and according to the initiatives of the government and Ministry of Education of China (MEC), schools have implemented many schemes, such as online course guidance [7]. ASD students need learning support, and assistive technologies (AT) may allow them to gain a more positive learning experience [8, 9]. In addition, learning media plays an important role in increasing students' interest in learning, especially in lower-grade classrooms because students cannot think abstractly. Therefore, it is necessary to visualize the learning materials in a more real or concrete form [10, 11].

The majority of lower-grade students prefer videos [12, 13]. Furthermore, the entertaining learning material specifically designed for ASD learners in previous studies was very limited, and most of the studies focused on neurotypical people [14–16].

On the other hand, the situation of children with ASD is another reason for acceleration in this study. The data released by the Centers for Disease Control and Prevention (CDC) shows that 1 in 54 children has ASD [17]. Data from the CDC showed that the incidence of ASD has increased to 1 in 44 children in 2018. It

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was discovered that the incidence rate increased by 1 in 36 children with ASD in 2020. In addition, more than 50 million children have developmental problems around the world, including ASD [18]. Although this is an estimated figure, the prevalence of ASD varies significantly from different studies. In addition, some strictly controlled studies have a much higher figure. The prevalence of ASD in many low and middle-income countries is unclear [19]. According to data from the United Nations Children's Fund [20] in 2023, there are 2,397,435,502.5 children under the age of 18, and if 1 in 100 children has ASD, then there are approximately 20 million children with ASD around the world.

Meanwhile, in the Basic statistics of special education published by the MEC, the number of graduates with disabilities reached 39,558. The number of graduates with mental disabilities in 2017 was 12,787 and increased to 25,164 in 2020 [21–24], ASD is an intellectual disability. Therefore, the figures indicated a rapid growth trend in the number of ASD graduates in China from 2017 to 2020.

The facts in the previous section showed that the number of children with disabilities (e.g., ASD children) has continued to increase. ASD students need to use AT for learning, as they should be respected alongside the general public as part of the national resource. Unfortunately, the MEC regularly provides excellent multimedia courseware resources every year, mostly for normal students, with little attention to ASD children. In March 2022, MEC upgraded the National Intelligent Education Platform for Primary and Secondary Schools to provide 44,000 basic education curriculum resources, including video resources for various courses, and courseware materials [25]. However, there are very few courseware materials related to special children. Therefore, ASD learners will face problems with information usability, which must be adapted to their learning activities. Otherwise, they will feel frustrated and have no pleasure in learning [26], which may affect the quality of their education.

As discussed earlier, it is important to recognise that teachers and students are not fully utilising and exploiting the learning object component. Furthermore, Ariffin [26] stated that advanced infrastructures such as Learning Management Systems and Learning Content Management Systems provide good support for accessing the content in the learning objects, which means that the technology is useful. In contrast, the human factor also needs to be taken into account to make the learning system work better in terms of content provision, access, and online browsing. As mentioned in the previous paragraph, a number of teachers do not make media materials available to students for learning, and not many students revisit courseware. The reasons for this should be further explored.

II. LITERATURE REVIEW

Khadka et al. [27] recognized that people with disabilities, especially children and adolescents, should receive a quality education similar to typical development students. In addition, Aziz et al. [28] also believed that education and life skills training for children with disabilities will help them to have a better future. A recent study has shown that the learning process of ASD students requires effective intervention plan support [29]. It is important to provide them with learning assistance and give them an engaging and inclusive learning environment [5, 30]. Many studies have proved that AT can help individuals with ASD and their families to better cope with learning and improve their well-being and daily functioning (e.g., communication, social, and problem–solving skills) [6, 31].

Over the past decade, there have been many studies using AT in education [34, 35] to help ASD learners [31]. For example, using interactive devices can enable 'shy' learners to learn better drawing skills, otherwise they may not choose to study in a more formal environment, such as studying in the studio with other students. In addition, learners can eliminate learning barriers, whether distance, time, language, 'shyness', disability, or cost [36].

In this context, the MEC is working to ensure that ASD learners can enjoy their rights in formal

education. Therefore, their achievements will not be neglected. Meanwhile, the MEC [7] believed that a high-quality special education system will be established by 2025, specifically including the guarantee of compulsory education for children with disabilities of age to 97%. At the same time, special pre-school education needs to be vigorously developed, and appropriate care, education, rehabilitation, and intervention services should be provided to children with disabilities as early as possible [24]. This demonstrates the importance of providing basic education for children with special needs.

However, learning difficulties are inevitable due to their limited technical capabilities and varying degrees of social barriers. In current practice, most learning tools are based on traditional learning materials that are provided by the MEC, and teachers use their full creativity and initiative. However, relying on these learning materials alone is not enough and students with special needs may lack interest or motivation to engage with the content [9]. Therefore, students with ASD, need specialized, individually planned learning material to maximize their potential and abilities.

Many people have tried to develop 'entertaining' learning materials that try to combine educational objectives with entertainment content. However, these learning materials often fail to fulfill either of these objectives and turn into a small market [37]. This reflects many difficulties in the implementation of entertaining learning material. With the efforts of the government and academia, entertaining learning content seems to have grown significantly in recent years, for example, the use of reality TV videos based on entertainment to help students learn [26], and the use of entertaining content based on games to help students learn [38, 39]. So far, most studies have focused on entertaining learning for neurotypical people [14, 15, 39]. Only a few studies have explored the effects of entertaining learning on students with ASD, as one study showed that students who have ASD tend to accept materials presented in a fun way rather than a straightforward curriculum [40].

Courseware is an interesting learning content that can help ASD students to learn, but some studies have indicated that most of the courseware content is electronic versions based on paper textbooks, and teachers seldom allow students to learn the courseware through AT (e.g., mobile devices). This largely resulted in a waste of educational resources [41]. In addition, a study by Koulias et al. [42] found that while students prefer to display learning materials in audio and courseware formats, they do not use them as expected. In other words, students may not reuse them. There are many reasons for this problem, but content packaging may be one of them. Content wrapping can show or hide certain materials according to rules defined in an educational scenario, and therefore can provide some additional flexibility in educational content [43]. Additionally, Dong et al. [44] found that students with ASD suffer from cognitive impairment, lack of basic knowledge, and social and communication constraints. Therefore, these students often encounter difficulties in their normal learning and teachers must teach according to their needs.

To clarify the factors that led to this finding, fieldwork and preliminary surveys were conducted. There are two main objectives: i) to gather information about usability courseware for ASD learners; and ii) to clarify the factors that contribute to ASD learners' need for courseware.

III. RESEARCH METHODS

This study is based on a qualitative approach as it focuses on the phenomena related to learners with ASD discussed in the previous section. This stage of this study (phase 1 and phase 2) took place at a special school located in an urban area in Zhejiang Province, China in 2023. With over 300 ASD students, this school provided ample opportunity to gather detailed information. The techniques used in this study are divided into two parts:

Phase 1 – For the fieldwork survey to investigate ASD learners' favorite activities and main leisure activities at home, questionnaires were

reprinted from a special school in China, in 2023, and were filled out by parents of ASD students, asking the parents to list their favorite activities and major leisure activities of ASD children at home (Table 1). The results of feedback from 10 parents showed that most ASD students' favorite activity was watching TV, followed by drawing.

Table 1: ASD students' favorite activities and main leisure activities at home

Students	Favorite activities at home	Main leisure activities at home
1	Drawing， watching TV	Playing iPad， drawing， watching TV
2	Playing ball	Watching TV， reading books， drawing
3	Watching TV	Watching TV
4	Watching TV， drawing	Drawing
5	Playing games， watching video	Playing mobile phone
6	Sinning， listening to music	Watching TV， reading books
7	Drawing， watching TV	Watching TV， drawing， reading books
8	Making things	Drawing， making things
9	Blowing bubbles	Doing housework， blowing bubbles
10	Watching TV	Watching TV， playing games

Phase 2 – For semi-structured interviews to investigate ASD learners' needs of courseware, all five respondents to this initial survey were teachers in special schools, and all had been teaching for more than three years. Therefore, they have a deeper understanding of the needs of students with ASD. The semi-structured interviews provided detailed information about the subjects' experiences and perspectives on the research topic [20]. During the interviews, eight questions were raised in a semi-structured form, as shown in Table 2.

The survey aims to investigate the following questions: Q1 whether the learners have been exposed to the courseware, if yes, then interviewed; Q2 whether courseware contains audio, graphics, animations, and videos; Q3 whether courseware is helpful to learners in the learning process; Q4 whether students are interested in watching courseware; Q5 whether the learners have experienced exposure to a courseware on the market; Q6 whether the courseware in the market is suitable for learners; Q7 whether there are specifically designed courseware in the market for students; and Q8 whether recommend suitable courseware specifically designed for students. Eventually, the interviews successfully gathered the results that need to be discussed.

Table 2: List of interview questions

Q1:	Are the learners exposed to the courseware?
Q2:	Do the courseware contain audio, graphics, animation, and video?
Q3:	Do the courseware assist the learners during the learning process?
Q4:	Do the courseware entertain students when viewing?
Q5:	Are the learners exposed to the courseware available in the market?
Q6:	Is the courseware available in the market suitable for learners?
Q7:	Is there any special courseware designed for learners available in the market?
Q8:	Do you recommend for a proper courseware that is specifically designed for learners?

IV. RESULTS AND DISCUSSION

In Table 3, all respondents answered positively to questions 1 and 2. Particularly, for question 1 which explores the exposure of learners to the courseware, the participants show their agreement. For question 2, all respondents agreed that the courseware was composed of multiple media elements. This showed that from the perception of the actual users, the design of the courseware is in line with the design principles. However, Table 3 also showed that the majority of respondents believe that courseware is helpful for children with ASD in different degrees (Q3), and although they contain a variety of media elements and activities, they are not always suitable for ASD learners (Q6). Why do some courseware not help ASD learners? This raises a further question: if courseware contains audio, graphics, animation, and video, what makes it less interesting? Furthermore, most respondents noticed that the market did not have courseware (Q7) specifically designed for ASD learners. However, all respondents suggested specifically

developing courseware for ASD learners, not only to develop courseware that seems interesting to typical development students but also to support the needs of ASD students (Q8), especially by providing multimedia elements in the courseware. Therefore, the results of the interviews indicated that the need for entertaining courseware is high and urgent among children with ASD.

Table 3: Respondents' opinion on the availability and the needs of courseware for ASD learners

Q	*R1	R2	R3	R4	R5
1	✅	✅	✅	✅	✅
2	✅	✅	✅	✅	✅
3	✅		✅	✅	
4		✅	✅		✅
5	✅	✅		✅	✅
6			✅	✅	
7	✅				
8	✅	✅	✅	✅	✅

Note: R1: Respondent 1, R2: Respondent 2, R3: Respondent 3, R4: Respondent 4, R5: Respondent 5; ✅: means agreed with the question or provided a positive response

Research on electronic screen media for students with ASD also supported the findings of the fieldwork in this study, Dong et al. [45] and Westby [46] found that ASD students tend to interact with media rather than engage in other play activities when they have more free time (e.g., on weekends), they watch more TV, play more computer games, and spend more time on the Internet and mobile phone. Therefore, they have more screen time than typical development students. In addition, one study showed that the majority of students with ASD have a clear preference for animated programs or websites [13]. As well, a recent study has shown that students with ASD prefer content produced for younger audiences, media content they can control and is easy to use, and content that promotes imitation [12].

In addition, the results of the semi-structured interviews indicated that courseware is neglected, and its effectiveness and entertainment cannot be guaranteed, especially for ASD students. As one study stated, although people did not know how to express their feelings, they would prefer it if there were applications that did not make them feel nervous while using them [26]. In addition, several studies have found that users tend to prefer minimizing clicks to access more content [47, 48]. In addition, Ariffin [26] added that easy-to-use products are not necessarily pleasant, and vice versa. The results of this preliminary study supported these claims that courseware is usable, but they are not always entertaining.

All the information discussed in the previous paragraphs is a good encouragement to seek learning material that learners are happy to use. Therefore, entertaining techniques have been analysed. However, most of the studies have focused on entertaining learning for normal people. Similarly, Pronchev et al. [49] and Ariffin [26] also suggested entertaing learning for normal people. Only a few studies have explored the impact of entertaining learning on children with special needs. For example, the results of a study showed that limited resources cannot attract the attention of students with special needs, while at the same time, teachers found entertaining animated programs can solve this problem [49]. As mentioned earlier, ASD students tend to accept material presented in an interesting way [40].

Additionaly, Wolf [51] also agreed that entertainment is becoming increasingly important in information technology applications. This view was supported by Ariffin [26] who argued that entertainment is characterized by a product that captures the interest of users and entertains users. Vorderer et al. [52] stated enjoyment is a state of 'pleasure' experience, which is considered 'the core of entertaining media'. Therefore, the relationship between these two elements is closely linked and interdependent. As applications begin to run on mobile platforms, UX-focused research needs to include enjoyment and overall hedonic attributes as prerequisites for user satisfaction with technology [53, 54].

In summary, despite many studies that have identified enjoyment as an important design element, many developers still produce content

that does not contain these elements. One possible reason for this is the nature of entertainment. Without creativity, experience, and technical skills, it would be difficult to produce entertaining learning material. This raises the following research questions:

- How can curriculum designers make sure that end users think that learning material is entertaining?

- Is it effective to learn entertaining learning content?

- How can teachers, especially non-technical staff, be enabled to produce learning materials that are perceived as entertaining?

There is an urgent need for research to respond to these questions, in particular, the development of a design model to ensure that the learning content is entertaining.

Compared to the results discussed in the previous section, this study presents student–centred learning (SCL) and self-paced learning (SPL) approaches, focusing on the needs of ASD learners for courseware. These two learning approaches are interrelated. The impact of SCL and SPL on this study will be discussed in detail in the next section.

SCL, also known as flexible learning, experiential learning, or self-learning, is a learning approach that focuses on the needs of students rather than on others (e.g., teachers or educational managers) [55]. The core elements of SCL are self-learning, experiential learning, self-experiential, and problem-solving learning in a collaborative environment [56]. With SCL, unlike teacher-centered learning, teachers are facilitators of learning. It fully focuses on the needs, capabilities, interests, and learning patterns of students [57], which is consistent with the entertaining learning material proposed in this study. On the other hand, SCL also encourages students to have direct access to multiple sources of information, such as books, online databases, and textbooks [58]. For ASD students, the media for their access to information is similar, but the knowledge is different from typical development students. For this purpose, this study attempts to combine SCL approaches to design courseware for ASD learners.

Tullis et al. [44] stated that SPL allows learners to follow learning preferences; in other words, learners can choose the form of learning outcomes, learning resources, learning needs, and learning styles. However, the core idea of SPL is to train models on simple samples first and then gradually add complex samples into consideration, which well simulates the learning process of humans and animals [59].

Houstis et al. [60] studied SPL from the perspective of learning speed. In a way, SPL helps everyone to acquire knowledge. In SPL, both slow and fast learners can choose their ideal learning preferences, which provides them with a learning advantage in achieving their learning goals [26]. In other words, SPL allows learners to determine the progress of the material based on each individual's own circumstances. This contrasts with traditional learning approaches, which generally use the 'average' learners as the reference point in classroom instruction, students who learn fast are forced to learn slower, and students who study slowly are not able to keep up, leading to larger learning level gaps between students. SPL is relatively 'reasonable' and each student learns at their own best pace. Because students have their own time to think, they find it easier to learn at their own pace. As Pendell et al. [61] stated, a useful SPL environment reduces embarrassment and anxiety levels and enables learners to learn new things freely. Furthermore, as mentioned earlier, the learning rate of ASD children is different from typical development children. Therefore, using SPL approaches can help them learn more flexibly.

Understanding the concept of SPL, including the informal component, is involved in this study. Informal learning usually occurs outside the formal classroom, is initiated and controlled by the learner, and involves conscious participation in independent action and interaction [62, 63]. Informal learning can be seen as lifelong, self-directed, and mostly without direct instruction [64]. In informal learning environments, learners

control learning, enabling them to better control learning opportunities, and choose what to learn [32, 65, 66]. Marsick et al. [63] argued that mentoring, coaching, networking, modeling, effective leadership and facilitation, team interrelationships, as well as personal characteristics and competencies can be considered informal learning strategies. In addition, Noe et al. [33] added that informal learning includes a variety of behaviors for learning new knowledge and skills, such as self-reflection, trying new ways of working, interacting with others, and reading work-related materials. Schools and other learning places need to develop learners with adequate competencies to better live in this world. Multimedia has great potential to support the learning process. This assumption also applies to informal learning places [67]. In summary, Sachs [68] argued that learning new skills and acquiring new knowledge cannot be limited to formal educational environments. By combining work and learning, people can learn in a work environment where they are solving real problems. Learning does not distinguish between locations and phases but integrates everything in the process of work.

The effectiveness of SPL to integrate other subjects has been proven [69, 70], but there is little research on SPL to integrate drawing learning. Previous studies have shown that interactive features, especially self-paced features, may benefit learning [71]. For example, Mayer et al. [71] argued that when learners can control their instructional presentations, they will achieve better learning outcomes. Hasler et al. [72] also found that students in SPL conditions had lower cognitive load and better learning outcomes compared to those in system control. Although many researchers have validated the self-paced function in multimedia learning, most studies have focused on its effects on adults [73] and have little knowledge of whether and how self-paced functions affect learning in children with ASD.

V. CONCLUSION AND RECOMMENDATIONS

In short, there is an urgent demand for AT-related entertaining learning materials specifically designed for ASD learners because there are few. Although a wide variety of courseware is available from the MEC and on the market, it is meaningless to ASD students. This also means that there is an urgent need for entertaining learning materials for ASD learners. This is unfair because students with ASD should and have the right to learn through AT. In addition, the survey findings and literature reveal those students with ASD face difficulties in using AT for learning. Based on the results of the preliminary study, this study aims to propose a courseware that can meet the learning needs of students with ASD. More importantly, they can acquire and understand the knowledge conveyed in the courseware by embedding SCL and SPL. Therefore, this needs more steps to be studied in depth.

Regarding limitations and recommendations for the study, firstly, the sample sizes in fieldwork and semi-structured interviews were too small and not representative. This may lead to the conclusion of the study not being very persuasive. Therefore, the present study suggests that more samples should be studied in future studies. Secondly, this study aimed to propose a courseware that satisfies students with ASD. Therefore, observations of students with ASD should be included in future studies, and not just investigate parents or teachers associated with students with ASD.

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