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Scaffolding in Intelligent Human Routine Supporter System

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ABSTRACT : *Social interaction is known to support learners to increase their learning understanding. Vygotskian social learning theory is reviewed and proposed theoretically with internet of things (IoT) implementation in human life routine. It is known IoT devices are planted scattered in the cities all around the world including on human routine path. Data communication between devices are integrated to an intelligent system. Scaffolding occurred during information transmission between these devices to an intelligent system. Collection of increasing information are analyze to forecast a display of new routine path. This paper projected theoretical possibilities in embedding social learning theory with digitize environment to support human being life routine.*

KEYWORDS– ***scaffolding, Vygotskian, internet of things, intelligent system, human routine***

I. INTRODUCTION

Social Development Theory or Social Learning Theory (SLT) highlighted collaborative activities in learning session between peers, tutors and learning aids will increased learners understanding. Lev Vygotsky described scaffolding in supportive learning environment will enhanced learners' knowledge exceeded their Zone of Proximal Development (ZPD) to their potential learning understanding. Vygotsky promoted on learning variety among peers will enhanced with learning understanding within supportive learning environment [1].

This paper proposed the adaption of Vygotkian SLT to digital environment with the application of IoT and artificial intelligent in relation to 4th industrial revolution highlights. Moving forward to Society 5.0 awareness where technology are being update to support and assist human being, the potential of internet of things (IoT) devices to perform as peers within supportive learning environment are possible. Thus, an intelligent system to support human life routine is proposed with adaptation of Vygotskian SLT.

II. BACKGROUND

Social Learning Theory promoted by Les Vygotsky described collaborative learning is best participated by leaners at different age, gender and academic background in supportive learning environment. Social interaction during learning session benefits the leaner to achieve their learning performance; and exceed to their potential learning understanding [1]. Social Learning Theory (SLT) promoted learning through social, interaction and communication in supportive learning environment existed not just from peers, but also from contributed learning aids example digital devices, learning materials, learning platform [2]. All learning aids located Zone of Proximal Development (ZPD) whereby learners scaffold till they are able to reach their potential learning development [3].

Typically, human are born to have the urge to live in a comfortable, safe and secure environment which is related to have a predictable and routine working or schooling schedule. Department of Statistics Malaysia reported in 2018, approximately 22.5 million are working, and 600,000 are students in higher institute reported in [4] and MCMC reported in their survey [5], 39.2 million smartphone are registered in Malaysia. This can be assumed, more than one smartphone are owned by employees and students in Malaysia. Smartphones enabled with internet connection or wireless module allow users to have the ability to transfer data between other internet connected devices or IoT devices. Both employee and students are bounded into either daily or weekly routine.

Routine can be described as regular series of movements or similar things used in a performance. It can be assumed as typical things human does for almost every day [6]. For example, an employee will to be at work from 9 am to 5.00 pm or a student will attend to classes at their university referred to their class schedule approximately from 8.00 am to 5.00 pm to local instate of higher learning in Malaysia. Over the weekends, grocery shopping, watching movies or recreational activity are conducted by them. Locations of these regular

activities are tracked and stored from individuals' smartphone using Global Positioning System (GPS) technology.

Notable rapid technology evolution in the 4th industrial revolution (IR4.0) has transformed both product and services offered by manufacturers, providers, business arenas including education institutions [7]. Innovations created to embrace this digitize information for example the Internet of Things (IoT), intelligent systems and robotics are expected to generate new added value to create super smart society by Society 5.0 [8]. Various needs of society are finely differentiated and met by providing the necessary product and services required to support human being. For example, to support the elderly; innovations at nursing-care facilities allows information connection and sharing between medical data users, check-up records, and able to put remote care services into practise. Future innovations need to support society transformation from hunting society, agrarian society, industrial society, information society to super smart society.

Digital gap between business and industry related with human routine activities are narrowed with innovations. For example, IoT technology applied agriculture has contributed to precision farming by controlled and accurate data to raise livestock and growing crops. Farmers able to monitor crop and livestock growth, health and location using drone equipped with digital information. Clean and sustainable vegetable and fruit farming are also possible with smart greenhouses technology implementation [9].

IoT in health and healthcare allows simultaneously reporting and monitoring patient health condition. Machine to machine communication, information exchange and data movement benefited to proactive treatments, improved diagnosis accuracy and treatment outcome results [10]. Other than that, real time information transmission between hospital or health institute and patient able to reduce health care cost [11].

Monitoring and controlling traffic congestion through far is not impossible with IoT. Information related with parking and traffic congestion or updates on long commute will allow user to plan their travel or find alternative for transportation to suite with employee or student routine activities [12 & 13]. Weekly shopping routine is supported with IoT technology implemented at shopping mall. The ability to track and count people at a crowded mall support customer experiences. Crowd congestion is predictable from data generated and share to customer effectively with data science technology [14].

Technology to support human routines is possible with the current usage of IoT devices implemented to normal human routine. Each day individual will usually have their own predictable routine with normal alarm clock (set hand phone), drive to work, have breakfast on the way to the office, conduct their work, have lunch at certain café, stop by at gym before home, reach home or stop for pick up kids, have dinner and sleep [6 & 15].

Each location planted with electronic devices capable to receive data related with environment information platform. Any updates or real time physical changes for example change with weather forecast or traffic condition; or certain routine café closed without prior notice, air quality or any hazardous information are sent to these devices scattered around hot spot/ routine route. Smart devices carried by human will logged all updates from these devices and processed as possible solution for the individual to change or divert his routine to avoid any mishap. In addition to this, new updates or information received by scattered devices will transferred to registered routine individual and processed as intervention to avoid problems [7. 15 & 16].

III. SOCIAL LEARNING THEORY FOR INTELLIGENT SYSTEM

Learning session happens through collaboration within supportive learning environment as described in earlier section. Cognitive understanding increment within zone of proximal development able learners to exceed to their potential learning understanding thus enable learners to cognitively suggest possible solutions for problems or issues. This review paper aims to suggest adaptation of social learning theory to an intelligent system. Nowadays, usage of technology to support industrial and business development [4] is wide and becoming norm to most people specifically an employed or students. It is interesting to know either technology really able to support human in regular activities not just an accessory to human gadgets. Reviews on literature have promoted scaffolding in Zone of Proximal Development (ZPD) can enhanced learner in achieving their learning potential without the requirement to have similar descriptive background for example age, gender, learning style or academic qualification [1 & 17].

Referring to Fig. 1, human routine can be mapped as normal learning performance. IoT devices act as learning tool with the ability to collect data from surroundings for example traffic and weather condition. These

data will be transfer to human wearable device. Scaffolding or data collection for scattered IoT device within human route and be added to an intelligent system. Increasing number of data received from various location from human daily routine are translated in important information that may need to be consider a new route to reach certain location.

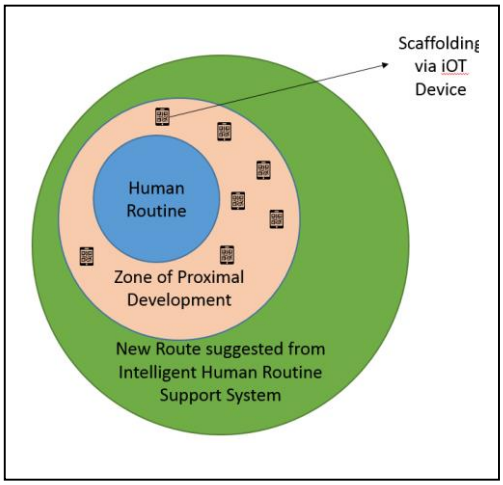

Figure 1: Adaption of ZPD in Vygotskian SLT to intelligent Human Routine System

Table 1: Vygotskian SLT mapped with Proposed Intelligent Human Routine Supporter System

Vygotskian learning environment	**Proposed Intelligent Human Routine Supporter System**
What is Known by learner [1 & 3]	Data tracked in human routine path
Learner can do unaided [2 & 16]	
Current ability [2]	
Scaffolding with activities [3 & 18]	Scaffolding using data exchange between IoT devices.
Cognitively prepared, but requires help and social interaction to fully develop [1 & 18]	
What is not Known [17]	Data forecasted to suggest new routine path
Learner can do with guidance [2 & 18]	
Learner cannot do [2 & 18]	
Potential learning development [1 & 3]	

Table 1 described mapped Vygotskian learning environment to a proposed intelligent Human Routine Supporter System called iRoute. Vygotskian SLT recommendation in current ability or known knowledge of learner is mapped to human routine or regular activities conducted by human. Tracked data are gathered from all IoT devices located in human routine path using GPS technology. In ZPD, learners are cognitively prepared to learn, however requires help and social supports from activities in learning environment. Scaffolding with activities is mapped to scaffolding using data exchange between IoT devices. Machine to machine communication or interaction will gradually increase stored data thus data forecasting are possible for better route suggestion. The potential learning understanding or what is not known is mapped with new route or proposed new activity based on information forecasted by the intelligent human routine supporter system. Positive or negative result from forecasted information can lead to new path for better outcome. For example to reach destination earlier with alternative transport, save groceries money with latest promotion information or registered to new health program suggested by subscribed insurance package.

IV. DISCUSSION

Technology to support human routines is possible with the current usage of IoT devices implemented to normal human routine [5]. Each day individual will usually have their own predictable routine with normal alarm clock (set hand phone), drive to work, have breakfast on the way to the office, conduct their work, have lunch at certain café, stop by at gym before home, reach home or stop for pick up kids, have dinner and sleep.

Data tracked in all location embedded with IoT devices will record digital information related to human routine surrounding environment. Any updates or real time physical changes occurs for example difference with weather forecast or traffic condition; or certain routine café closed without prior notice, air quality or any hazardous information are transmit to these devices scattered in routine route. Smart devices wearable or carried by human will logged all updates information and processed as possible solution and suggestion for individual to change or divert his routine to avoid any mishap.

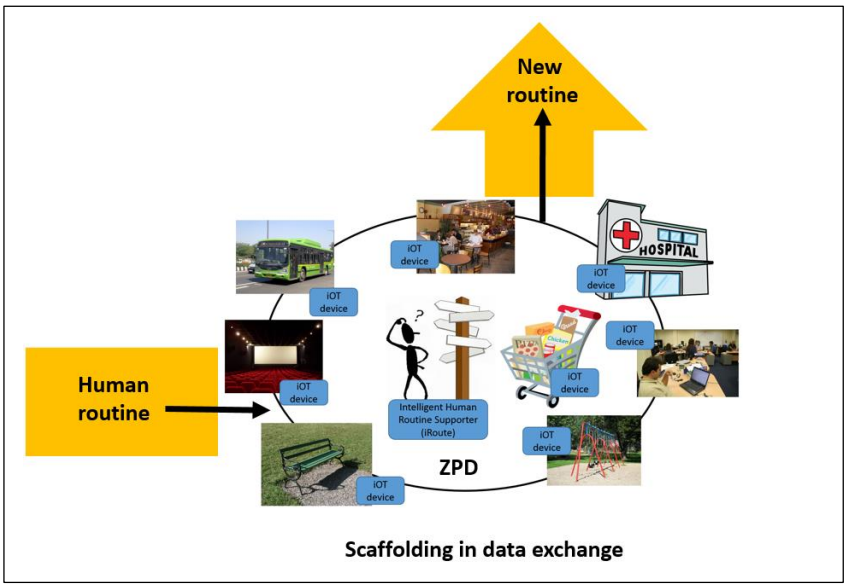

Figure 2: Proposed intelligent system (iRoute) to support human routine

Fig. 2 described the potential of an intelligent system called iRoute to support human routine path or ZPD by suggesting new route to their regular path for routine activities. Vygotskian learning theory adaptation in relation with activities scaffolding to achieve potential performance is applied. It is possible to design an intelligent system with the ability to collect and analyze data from various IoT location. Data exchange between these devices or data scaffolding will forecast information thus enable human or user to plan new route. For example, traffic condition, weather changes, crowd congestion in grocer shop or sudden changes in appointment. These information are possible to be integrated thus enable any employee or student to plan their transportation to avoid traffic congestion, new grocery store to make weekly shopping, new activity to replace postponed appointment.

V. CONCLUSION & RECOMMENDATIONS

This research aims in Vygotskian social learning theory adaptation to digital environment in order to support human with suggestion for better decision. Data exchange during communication between devices within ZPD are integrated in research proposed intelligent system called iRoute. iRoute will displayed suggestion for new routine path or also known as potential performance in Vygotskian SLT. It is recommended to develop a prototype with the ability to integrate data from different devices, analyse current and new collected data and finally display suggestion for better path in addition to regular routine path. In addition to that, policy related to data security need to be enhanced to avoid data misusage by unauthorized party.

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